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Technical Report No. S.0023115-14, November 2015
Epidemiology and Disease Surveillance Portfolio/Injury Prevention Program

Evaluation of Injuries among Command and General Staff College Students, Ft. Leavenworth, Kansas

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13. SUPPLEMENTARY NOTES

14. ABSTRACT Two years after the closing of the Army Physical Fitness Research Institute, an active duty Army physical therapist was once again assigned to serve Army Command and General Staff College (CGSC) students. **Purpose:** To evaluate the effects of a physical therapist on injuries and physical fitness of CGSC students and assess risk factors for injury. **Methods:** Demographics, health behaviors, physical training (PT) activities, and Army Physical Fitness Test (APFT) results were collected by survey from CGSC Class 14-02 at the start and end of the 10-month course. The CGSC Class 13-02, one year prior, did not have an assigned physical therapist and was used for comparison. For both classes, administrative APFT records were obtained from CGSC and injury medical encounter data were obtained from the Military Health System Management Analysis and Reporting Tool (M2). **Results:** Electronic medical records were available for 293 (99%) students in Class 14-02 and 284 (97%) students in Class 13-02. For Class 14-02, cumulative injury incidence did not differ from injuries one year prior to CGSC (56.1% vs. 56.3%, p=0.93). Class 14-02 injury incidence also did not differ from Class 13-02 (56% vs. 54%, p=0.50). Responses from students who completed initial and follow-up surveys (n=38) showed improvements in APFT run times and push-ups and no changes in body composition. The proportion who conducted sprint training 1-2 times per week decreased slightly during CGSC (78% vs. 53%, p=0.06); no other changes in PT activities were observed. An analysis of injury risk factors found students with an injury in the year prior to CGSC were nearly 4 times more likely to be seen for an injury during CGSC, controlling for age and gender. **Conclusions:** There were no measured effects of the CGSC physical therapist on injury treatment among CGSC students and fitness changes could not be attributed to the presence of the CGSC physical therapist, therefore a recommendation for or against the placement of a physical therapist at the CGSC cannot be made. Modifiable barriers to program implementation at CGSC should be addressed, including the lack of formal mechanisms to engage with CGSC students, geographic separation of the physical therapist and students, and administrative challenges. Evaluation of a modified program is warranted, as efforts to operationalize and institutionalize education of future Army leaders on injury prevention and performance optimization at locations such as CGSC have the potential to positively affect the health and performance of these leaders, as well as the health and performance of their Soldiers.

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1 Summary

1.1 Purpose

In 2011, the Army Physical Fitness Research Institute (APFRI) was closed and its staff disbanded, ending health promotion and performance optimization services at its prior locations: the Army War College, the Army Sergeants Major Academy, and Command and General Staff College (CGSC). Before closure of the APFRI, the physical therapist assisted with providing health promotion and performance optimization services but did not treat patients.

Starting in 2013, an active duty Army physical therapist was once again assigned to serve the CGSC students, with the intent of providing clinical care as well as injury prevention education to CGSC students in order to facilitate prevention of injury, early treatment of new injuries, and improved rehabilitation of existing injuries. Using data from students who attended CGSC from February to December 2014 (Class 14-02), this evaluation sought to (1) evaluate the effects of the physical therapist on injuries and physical fitness of CGSC students and (2) identify risk factors for injury among CGSC students.

1.2 Results

Slightly fewer than 300 U.S. Service Members (n=296) were enrolled in CGSC Class 14-02. Of those enrolled, 185 (63 percent) completed the initial survey in January 2014. Among those who took the initial survey, most were male (83 percent), over 30 years of age (100 percent), Army (99.5 percent) and active duty (91 percent), and a rank of O3-O4 (99 percent). Over one-third (34 percent) of CGSC Class 14-02 students had a 'normal' body mass index (BMI) according to Centers for Disease Control and Prevention (CDC) BMI classifications, while 55 percent were 'overweight' and 11 percent were 'obese'. Very few were current cigarette smokers (3 percent), though 11 percent used smokeless tobacco.

Regarding personal physical training (PT) upon entry to CGSC, 20 percent of male and 26 percent of female students reported running more than 15 miles per week. Over half (51 percent) of survey respondents performed aerobic endurance exercise (other than running) 1 to 2 times per week, 42 percent performed resistance training 3 to 4 times per week, and 54 percent performed sprint training 1 to 2 times per week. Respondents also completed other physical training programs such as cross-training programs (15 percent) and Crossfit (14 percent), and only 8 percent based their personal PT program on traditional Army physical training. At the time of the initial survey, only 8 percent of respondents had visited the physical therapist and only 18 percent planned to visit the physical therapist.

Changes in physical fitness and health behaviors in Class 14-02 during CGSC were assessed by comparing responses to the initial and follow-up surveys. Of the 296 U.S. Service Members originally enrolled in Class 14-02, ten did not complete CGSC or deferred attendance and one student could not be verified, leaving 285 class members. A total of 55 (19 percent) responded to the follow-up survey.

Responses from students who completed both surveys (n=38) were used to assess changes in physical fitness and health behaviors during CGSC. In this evaluation sample, most students were male (87 percent), age 35 to 39 (45 percent), Army (100 percent) and active duty (87 percent), and the greatest proportion (58 percent) were combat service support.

Students in the evaluation sample improved their Army Physical Fitness Test (APFT) performance while attending CGSC, with statistically significant improvements in cardiorespiratory endurance (2-mile run time) and muscle endurance (push-up repetitions). There were no changes in body composition as measured by the proportion of students in each CDC BMI category (p=0.92). There was also no change in the proportion of cigarette smokers or smokeless tobacco users during CGSC. Only one marginally significant change in personal PT activities was observed: prior to CGSC, 78 percent of students reported sprint training sessions 1-2 times per week, while during CGSC only 53 percent reported maintaining sprint training sessions 1-2 times per week in their personal PT program (p=0.06).

Among all those who took the follow-up survey and had been injured, approximately half (52 percent) were referred to Physical Therapy and only 27 percent saw the CGSC physical therapist. Among all survey respondents, only about half (53 percent) were aware that a physical therapist was assigned to specifically work with CGSC students. Approximately half (55 percent) were aware of early morning physical therapy appointments offered by the CGSC physical therapist at the nearby Army Wellness Center, but few reported utilizing these appointments (n=6). If a physical therapist was co-located at the school, 77 percent reported they would be likely or very likely to take advantage of an injury prevention consultation or additional injury treatment.

To enable the most complete comparison of injuries possible, injury analysis was not limited to the evaluation sample (i.e., those who took both surveys). Medical records were obtained for 284 (97%) students in Class 13-02 and 293 (99%) students in Class 14-02. For Class 14-02, the cumulative injury incidence was not statistically significantly different from the proportion injured 1 year prior to CGSC attendance (56.1 vs. 56.3 percent, p=0.93). The proportion injured during CGSC for the class with a physical therapist (Class 14-02) was not statistically different to the proportion in the class without a physical therapist (56.3 vs. 53.5 percent, p=0.50). The incidence of lower extremity injury was also not statistically different in either of the classes (39.2 vs. 33.5 percent, p=0.15). Injury incidence prior to CGSC was statistically higher for the class with the physical therapist (56.1 vs. 45.6 percent, p=0.01).

Between both classes, over 90 percent of injuries were treated by Physical Therapy, Family Practice (not otherwise specified), and Orthopedics. A greater proportion of injuries in Class 14-02 were treated by Physical Therapy compared to the prior class (41.2 vs. 37.8 percent, p=0.04), and fewer injuries were treated by the Orthopedic Clinic (19.5 vs. 13.7 percent, p<0.001).

Medical records also indicated that the leading traumatic injuries sustained during CGSC for Class 14-02 were sprains and strains (52.5 percent) and fractures (20.3 percent). Leading body regions affected were the lower extremity (32.2 percent) and upper extremity (39.0 percent). The leading injury-related musculoskeletal diagnoses during CGSC for Class 14-02 were inflammation and pain (62.2 percent). Leading body regions affected by injury-related musculoskeletal conditions were the spine and back (54.1 percent) and lower extremity (27.0 percent).

An analysis of risk factors for injury during CGSC found injury in the year prior to CGSC a strong independent predictor of injury risk during the CGSC, controlling for age, gender, and MOS. Those with an injury in the year prior to CGSC were nearly 4 times more likely to be seen for an injury during CGSC. When risk factors for a lower extremity (LE) overuse injury during CGSC were assessed, students with a LE overuse injury in the year prior to CGSC were 5 times more likely to be seen for a LE overuse injury during CGSC.

1.3 Conclusions and Recommendations

This evaluation found that cardiorespiratory endurance and muscle endurance as measured by APFT performance improved slightly and body composition and injury incidence did not change over the 10-month CGSC course for the class with a physical therapist (Class 14-02). Maintenance of and improvements in physical fitness are notable, given that the students were in a school environment with classroom activities that are inherently sedentary. Injury incidence did not differ from a previous CGSC class and did not change during CGSC. Overall, fitness changes could not be attributed to the presence of the CGSC physical therapist and there were no measured effects of the physical therapist on injury treatment among the Class 14-02 students.

Despite a lack of short-term impact on injuries and physical fitness, there were lessons learned about the program. Clinic use data indicated that injuries were most commonly treated by physical therapy in the class with the physical therapist (Class 14-02), suggesting that specialized injury care was being received. However, survey data showed that the CGSC physical therapist was not specifically utilized, as only 27 percent of those referred to physical therapy were seen by the CGSC physical therapist. Only 53 percent were aware that a physical therapist had been assigned to consult with and treat CGSC students and only 55 percent were aware of pre-class morning appointments available with the CGSC physical therapist at the nearby Army Wellness Center. Over three-fourths (77 percent) of follow-up survey respondents indicated they would have taken advantage of an injury prevention consultation or additional injury treatment if the physical therapist was co-located at the school.

Based on this evaluation, we cannot recommend for or against the placement of a physical therapist at the CGSC. Modifiable barriers to program implementation included the lack of formal mechanisms to engage with CGSC students, geographic separation of the physical therapist and students, and administrative challenges. To enhance utilization of the CGSC physical therapist, the following actions are recommended:

(1) Clearly define the intent and objectives of the CGSC physical therapist;

(2) Communicate the intent and objectives to stakeholders including the Munson Army Health Center leadership, CGSC leadership, and CGSC students;

(3) Coordinate with CGSC leadership to identify mechanisms to inform students of the injury prevention and performance optimization consultation services available through the CGSC physical therapist and to increase opportunities for interaction, with the ultimate goal of establishing routine interaction and education;

(4) Continue to offer early morning appointments at the nearby Army Wellness Center or to pursue co-location of the physical therapist, given that student survey responses indicated co-location was desired;

(5) Work with Munson Army Health Center leadership to overcome administrative obstacles such as the scheduling system in order to provide the ability for the CGSC physical therapist to focus his/her patient care on CGSC students;

(6) Obtain Munson Army Health Center leadership support for the program, to ensure the CGSC physical therapist has the ability to dedicate time to CGSC injury prevention and performance optimization activities.

Evaluation of future program effects on injuries among CGSC students is warranted. While injury and physical fitness are key outcomes to assess, future evaluations should consider collection of additional measures such as more precise measures of time to return to duty, functional status, and quality of life. Other measures to consider include general physical health, mental health, quality of work life, and medication use. If educational activities are introduced at CGSC, Short-term impact, such as knowledge gained from educational activities should be measured. An assessment of the long-term impact of the education and treatment received on the future health and performance of these leaders, and the health and performance of their Soldiers should also be considered.

2 References

See Appendix A for references.

3 Authority

The authority for this evaluation is Army Regulation 40-5, paragraph 2-19a, which tasks the U.S. Army Public Health Center (Provisional) (APHC (Prov)), (formerly Army Public Health Command and U.S. Army Center for Health Promotion and Preventive Medicine), to provide "support of Army preventive medicine activities through consultations, program evaluations…in the areas of disease and injury prevention and control…health surveillance and epidemiology…" (Department of the Army (DA) 2007).

4 Background

In 2011, the Army Physical Fitness Research Institute (APFRI) was closed and its staff disbanded due to funding, ending health promotion and performance optimization services at its prior locations: the Army War College, the Army Sergeants Major Academy, and the CGSC. Before closure of the APFRI, the physical therapist assisted with providing health promotion and performance optimization services, but did not treat patients. (For further description of the APFRI concept and services, see Parker et al. 2001). Starting in 2013, an active duty Army physical therapist was once again assigned to serve CGSC students. Specifically, the physical therapist was assigned to Munson Army Health Center at Fort Leavenworth, Kansas, along with an active duty Army dietician as part of the Executive Wellness Program. Physical therapist duties were focused on providing clinical care as well as physical fitness and injury prevention instruction.

The need for enhanced injury care and injury prevention instruction is evident, given that injuries are a leading health issue for the Army (Jones et al. 2010). Senior leadership is not exempt. Two previous investigations of injuries among Army War College students showed injury incidences of 44 percent (2000) and 56 percent (1999) during the 10-month academic year (USACHPPM 1999; USACHPPM 2000). Physical fitness training-related injury rates were 49.7 percent during one academic year at the Sergeants Major Academy, according to a 1995 medical record review (Cosio-Lima et al. 2013).

This evaluation focused on students enrolled in the residential Command and General Staff College Intermediate Level Education (ILE) course, which is part of the Command and General Staff School (CGSS) at Fort Leavenworth, Kansas. ILE is a 10-month Army graduate program that educates, trains, and develops field grade officers for leadership positions with a focus on preparing students for joint, interagency, intergovernmental, and multinational operational environments. Students from any U.S. Armed Service or U.S. governmental agencies may be selected to attend as part of their career progression.

4.1 Physical Therapists in the U.S. Army

The concept of assigning physical therapists to serve particular units is not new; physical therapists have deployed to combat areas since the Vietnam War, valued in particular for their expertise in evaluating and treating nonsurgical musculoskeletal conditions. Studies have shown that medical schools and non-orthopedic residency programs do not sufficiently educate physicians on musculoskeletal medicine (Matzkin et al. 2005; Clawson et al. 2001; Freedman and Bernstein 1998). In the absence of physical therapists, the burden of injury diagnosis and treatment inordinately falls upon orthopedic surgeons (Davis el al. 2006). Having a physical therapist who can serve as a 'physician extender', allowing orthopedic surgeons to focus on surgical cases, has proven invaluable in many combat settings (Davis et al. 2006; Garber and Baxter 2004; Greathouse et al. 1994). Availability of specialists in musculoskeletal injury care is especially important for the Army, given that injury is the most common reason for seeking medical care during deployment (Belmont et al. 2010; Cohen et al. 2010; Hauret et al. 2010) and in garrison (Jones et al. 2010), with over 1.3 million injury-related medical encounters in 2012 alone (Marshall et al. 2013).

The advantages of forward-deployed physical therapy care include early treatment and diagnosis, avoidance of referral wait time or avoidance of medical evacuations from theater, maintenance of personnel strength and unit cohesion, and higher Soldier and leader satisfaction with care (Moore et al. 2013; Zambraski and Yancosek 2012). When physical therapists have deployed on field training missions, reports suggest that one-third or more of all sick call visits are treated by the physical therapist and a majority (>90 percent) are returned to duty (Moore et al. 2013; Davis et al. 2006; Greathouse et al. 1994). Physical therapists are also trained in health promotion and injury prevention and can serve as advisors to commanders and Soldiers with regard to physical fitness, PT, performance optimization, and injury prevention (Garber and Baxter 2004; Greathouse et al. 1994). At CGSC, the intent was for the CGSC physical therapist to provide injury prevention education as well as clinical care to students in order to facilitate prevention of injury, early treatment of new injuries, and effective rehabilitation of existing injuries.

4.2 Physical Therapy at the CGSC

The CGSC physical therapist was assigned to the Preventive Medicine Department of Munson Army Health Center in June 2013 as part of the Executive Wellness Program, with a primary duty station at the Physical Therapy Clinic. While most patient care took place at the Physical Therapy Clinic, the physical therapist also offered morning appointments a few days a week at the Fort Leavenworth Army Wellness Center, which occupies a building adjacent to CGSC classrooms. Appointment hours were offered during times that would not conflict with class schedules (classes typically started at 0800; the Army Wellness Center opened at 0630). The CGSC physical therapist did not have formal interaction with students, such as course lectures. The CGSC also did not have morning unit physical training activities. As a result, the physical therapist was not able to meet expectations for injury prevention education of CGSC students, either through formal classes or indirectly through physical training activities.

The purpose of this evaluation was to assess the effects of the CGSC physical therapist. Using data from students who attended CGSC from February to December 2014 (Class 14-02), this evaluation specifically sought to (1) evaluate the effects of the physical therapist on injuries and physical fitness of CGSC students and (2) assess risk factors for injury among CGSC students.

5 Methods

5.1 Data Collection

The APHC (Prov) began evaluation planning in October 2013, in consultation with the CGSC physical therapist and Office of the Surgeon General Rehabilitation and Reintegration Division and following initial discussions during the Army Medical Specialists Corps Injury Prevention/Human Performance Optimization Council.

In January 2014, the APHC (Prov) Public Health Review Board reviewed and approved the project as public health practice. All analyses and storage of electronic data for this project occurred on U.S. Army computers and networks approved for storage of sensitive information.

5.1.1 Surveys

In January 2014, APHC (Prov) designed a survey in consultation with the CGSC physical therapist and prepared the survey for online administration using the using Verint® electronic survey software (version 7.2.140715.14). Survey administration pre-tests indicated that the survey took 12 minutes to complete (entering the maximum number of injuries). Class 14-02 started on 10 February 2014 and graduated on 12 December 2014. After approval from the Munson Army Community Hospital Deputy Commander for Clinical Services (DCCS), the initial survey (Appendix B) was administered at a dedicated station during student in-processing from January 27 to 30, 2014. The CGSC physical therapist coordinated with in-processing staff to secure the survey area and necessary equipment. The APHC (Prov) provided a link to the electronic survey. The link was available on computers dedicated to survey administration at the in-processing site. The CGSC physical therapist attended the survey station over the 4-day period, directing students to the computers and survey, informing them of its voluntary nature, and answering questions as needed. The survey collected information on injury risk factors (e.g., physical activities, tobacco use), and injuries prior to CGSC. Given that a dietician was part of the CGSC Executive Wellness team along with the physical therapist, dietary habits were of interest to the tasking authority and were also captured in the survey.

A follow-up electronic survey (Appendix C) was prepared in June 2014 using Verint® electronic survey software (version 7.2.140715.14), in time for administration prior to Class 14-02 graduation. Due to the retirement of the CGSC physical therapist and administrative challenges from October 2014 to December 2014, survey administration was delayed. Following the graduation of Class 14-02 in December 2014, the CGSC no longer had access to the students. The APHC (Prov) staff identified email addresses for Class 14-02 students through searches of student names in Army Knowledge Online (https://www.us.army.mil). A survey link was sent to all email addresses obtained by the search. Subsequent email reminders were sent once a week for two consecutive weeks. The follow-up survey was open for 18 days.

5.1.2 Unit Rosters and Physical Fitness Data

A 14-02 class roster was obtained by the CGSC physical therapist in January 2014 during the initial survey administration. In June 2015, following retirement of the CSGC physical therapist and with the Office of the Surgeon General assistance, an alternate point of contact from the CGSC U.S. Student Division (USSD) was identified in order to obtain unit records of APFT results. APFT data were manually entered into a Microsoft Access data file and included name, age at testing, height, weight, body fat percentage (if did not pass height and weight screening), body fat pass/fail status, APFT date, scores for push-ups, sit-ups, 2-mile run time, and APFT pass/fail status. See Field Manual (FM) 21-20

(DA 2012) for a detailed description of the APFT. Physical fitness data were transferred to SPSS for further analysis.

5.1.3 Electronic Medical Records

Electronic data for injury-related medical encounters for Class 14-02 were obtained from the Military Health System Management Analysis and Reporting Tool (M2). The class was defined using the initial roster obtained by the CGSC physical therapist in January 2014. Data included inpatient and outpatient encounters at military treatment facilities as well as purchased care encounters. The following information was obtained for each injury-related medical encounter encompassing CGSC attendance (January to December 2014) and 1 year prior to attendance (January to December 2013) in order to assess injury prior to CGSC: visit date, ICD-9-CM diagnosis code(s) and ICD-9-CM external cause of injury codes (E-codes), Standard North Atlantic Treaty Organization Agreement cause codes (inpatient only), disposition status, discharge date (inpatient only), and clinic where treatment was received. The following demographic information was also obtained: name, date of birth, gender, race, Service, Component and rank.

5.1.4 Comparison Class

Medical encounter and APFT data for the CGSC winter class in the previous year (Class 13-02) were obtained for comparison purposes, since a physical therapist was not assigned to work with this class. To identify members of that previous class, a class roster was obtained from the Army Training Requirements and Resource System (ATRRS) in May 2015. ATRRS is the Army Management Information System of Record for managing training, including student information and class status and contains information on active duty Service Members only. M2 injury-related electronic medical records data were pulled in June 2015 for Soldiers on the ATRRS roster for the period of CGSC attendance (January 2013 to December 2013) and for 1 year prior to attendance (January 2012 to December 2012) in order to assess injury prior to CGSC, using methods described for Class 14-02. APFT cards for Class 13-02 were obtained from the CGSC U.S. Student Division (USSD). APFT data were manually entered into a Microsoft Access data file and transferred to SPSS for analysis.

5.1.5 Semi-structured Interview with CGSC Physical Therapist

A semi-structured interview was held with the CGSC physical therapist at the start and end of the class year. The initial interview gathered background and the perceived role of the CGSC physical therapist, while the final interview gathered details of the strengths, weaknesses, and lessons learned after one class cycle.

5.2 Data Analysis

5.2.1 Survey Data Analysis

Unless otherwise specified, IBM SPSS® Statistics, version 19, was used for all data management and analyses. Data obtained from the initial survey and follow-up surveys were merged. Military occupational specialties were grouped according to Department of Army occupational code groupings defined in FM 7-21.13 (DA 2004). Current cigarette smokers were defined as those Soldiers who smoked at least one cigarette within the last 30 days and smoked 100 or more cigarettes in their lifetime. Current smokeless tobacco users were defined as those Soldiers who reported smokeless tobacco use in the last 30 days. Physical fitness was assessed using performance on the most recent APFT and BMI calculated from self-reported height and weight. The BMI was calculated as weight in

kilograms divided by height in meters squared (kg/m²) and was categorized according to the CDC (CDC 2015) classifications for underweight (< 18.5), normal (18.5-24.9), overweight (25.0-29.9), and obese (≥ 30). The "overweight" category was further split into 'low overweight' and 'high overweight' categories with cut-points consistent with the highest allowable BMI for men (27.5 kg/m^2) and women (26.0 kg/m^2) as described in AR 600-9 (DA 2013). Weekly running distance for personal PT was calculated from self-reported average running frequency per week multiplied by average miles per run.

Descriptive statistics on physical therapy services and injury prevention topics of interest were reported for initial survey respondents. Descriptive statistics on physical therapy use during CGSC were reported for all follow-up respondents.

To enable the comparison of individual-level changes in injury and fitness, an evaluation sample was created from those CGSC students who had responded to both the initial and follow-up survey, i.e., individuals for whom data was available both at the start and at end of the CGSC. Changes in APFT performance were assessed using a paired t-test. Changes in BMI category, tobacco use, and personal physical training activities were assessed using Mantel-Haenszel chi-square statistics.

In addition, to assess potential differences between survey respondents and non-respondents, medical record and unit APFT data on all CGSC students in Class 14-02 was obtained. Demographics, injury incidence, and APFT performance were compared. Data on international students could not be included in this comparison given that electronic medical records and APFT results were not available for these students. For comparisons of categorical data, results of Mantel-Haenszel chi-square tests of proportion are reported. For comparisons of continuous (APFT) data, results of t-tests are reported.

To assess the validity of self-reported APFT data among the CGSC students, self-reported APFT survey data were compared to unit records using Pearson correlation coefficients, which are reported. The strength of the association was determined by the following established limits: correlations from 0 to 0.25 indicate little or no relationship; from 0.25-0.5 indicate a fair degree of relationship; from 0.5 to 0.75 indicate a moderate to good relationship; and greater than 0.75 indicate a very good to excellent relationship (Dawson 2004).

5.2.2 Electronic Medical Records Analysis

Frequencies and distributions of demographic and injury data from the electronic medical records are reported for Class 13-02 and 14-02. A student was defined as having 'one or more injury' during CGSC if they had one or more visits containing an injury ICD-9-CM code between January and December 2014. An injury code could be present in one of the first four diagnosis codes of a medical encounter. Although classes did not start until February, according to the CGSC USSD, students reported during the second week of January for in-processing and prerequisites started the third week of January. In addition, graduation occurred during the second week of December, so the month of December was considered a transition time and included in the period of observation.

The following three injury indices were reported: (1) The Installation Injury Index (III) includes traumatic and environmental injuries (ICD-9-CM 800-999) and selected injury-related musculoskeletal conditions (ICD-9-CM 710-739), consistent with Department of Defense (DOD) Military Injury Metrics Working Group recommendations (DOD Military Injury Metrics Working Group 2002) and DOD injury surveillance activities (Jones et al. 2010; AFHSC 2015); (2) The Comprehensive Injury Index (CII) includes a slightly broader set of codes beyond those included in the III, with the addition of selected nerve injuries (ICD-9-CM 320-389), osteoarthritis (ICD-9-CM 715), arthropathies (ICD-9-CM 716), and unspecified joint disorders (ICD-9-CM 719.50-719.99) consistent with expanded definitions used in prior Army injury investigations (Knapik et al. 2010; Grier, Knapik et al. 2011; USAPHC 2012; Knapik et al. 2013); and (3) The Training-Related Injury Index (TRII) is a subset of the III that includes diagnoses

specific to lower extremity overuse injury, consistent with Army initial entry training surveillance activities (Knapik et al. 2006) and prior Army injury investigations (Knapik et al. 2010; Grier, Knapik et al. 2011; USAPHC 2012; Knapik et al. 2013). Specific ICD-9-CM codes used in each index are available in USACHPPM 2004.

To assess the effects of assigning a physical therapist to serve the CGSC students compared to a class not having a physical therapist assigned, the proportion of students injured in Class 14-02 was compared to the proportion injured in Class 13-02. Differences in the proportions injured during their academic year were assessed using the Mantel Haenszel chi-square test statistic available in OpenEpi (Sullivan, 2015), which assesses statistical association between the two groups using the z-score. The risk ratio and 95 percent confidence interval (95 percent CI) around the risk ratio were reported.

To assess differences in clinics providing injury treatment between classes, the distributions of all injury visits by clinic were presented for each class. The CGSC physical therapist recorded his visits under the Physical Therapy Clinic code, BLAA.

Finally, injury diagnoses and body regions affected are summarized for Class 14-02 using the Barell Matrix (Barell et al. 2002) for all traumatic injury visits (ICD-9-CM 800-999). The injury-related musculoskeletal matrix (Hauret et al. 2010) is used to summarize all visits for injury-related musculoskeletal conditions by diagnosis and body region. For these matrices, the primary (first) diagnosis code in the record is used. Where the primary code is a V-code or is not a code included in the pre-defined matrix cells, the visit is not included in the matrix.

5.2.3 Risk Factors for Injury during the CGSC

To assess risk factors for injury among CGSC students, univariate and multivariable logistic regression models were run using the electronic medical record data on all injuries and lower extremity overuse injuries occurring during the CGSC for Class 14-02. Risk factors were obtained from initial survey responses or demographics available from medical records. Percent body fat was used in place of BMI. Estimated percent body fat was calculated using an equation described by Gallagher et al. that considers age, gender, and BMI and then grouped in tertiles. APFT run times, sit-up, and push-up performance were grouped into tertiles of performance (i.e., fastest, moderate, slowest or lowest, moderate, highest). Multivariable logistic regression models were used to identify factors associated with (1) any injury and (2) lower extremity overuse injury risk during CGSC A backward-stepping model was used to explore independent predictors ($p \leq 0.05$ required for entry into the model; $p \geq 0.10$ required for removal from the model). Independent predictors identified in this model were then entered into a model that controlled for known injury risk factors (age and gender) and other demographic factors associated with injury according to univariate statistics (i.e., univariate model showed statistical significance of ≤0.10 either overall or in an individual category). Odds ratios and 95 percent CI of univariate models and the final multivariable models are reported. Injury risk ratios and 95 percent CI were also calculated and are presented in Appendix K.

6 Results

6.1 Initial Survey Results

The 14-02 class roster obtained by the CGSC physical therapist in January 2014 indicated that 296 U.S. Service Members were enrolled in CGSC Class 14-02, a count that does not include international students. Of those enrolled U.S. Service Members, 185 (63 percent) completed the initial survey in January 2014. A total of 154 (62 percent) of the 247 male U.S. students and 31 (63 percent) of the 49

female U.S. students responded. A comparison of survey respondents and non-respondents can be found in Appendix D. A summary of demographics, physical characteristics, APFT performance, and tobacco use reported on the initial survey are below.

6.1.1 Initial Survey Results: Demographics, Physical Fitness, Health Behaviors, and Physical Therapy Use on Entry to CGSC

Among those who took the initial survey, most were male (83 percent), over 30 years of age (100 percent), Army (99.5 percent) and active duty (91 percent), and a rank of O3-O4 (99 percent) (Table 1). The average age of students' was 36 years old (Table 1).

Table 1. Demographics, Class 14-02 Initial Survey (n=185)

Variable	Category	Responders
Gender	Male	154 (83%)
	Female	31 (17%)
Age (years) (Mean: 35.5 ± 3.7; Range: 30-45)	30-34	92 (51%)
	35 to 39	58 (32%)
	≥ 40	30 (17%)
	Missing	5
Branch of Service	Army	184 (99.5%)
	Navy	1 (0.5%)
Component	Active duty	168 (91%)
	Reserve	7 (4%)
	National Guard	8 (4%)
	Other	2 (1%)
Rank	O3	82 (44%)
	O4	101 (55%)
	O5	1 (<1%)
	Other	1 (<1%)

6.1.2 Physical Characteristics

Overall, 34 percent of CGSC students had a 'normal' BMI according to CDC BMI categorization, while 55 percent were 'overweight' and 11 percent were 'obese'. As shown in Table 2, on average, males had a BMI of 26.7 ± 2.7 kg/m² and females had a BMI of 23.9 ± 2.5 kg/m². Most males were in the CDC BMI 'overweight' category (60 percent) and most females fell into the CDC BMI 'normal' weight category (71 percent) (Table 2). The average male height was 70.5 ± 2.8 inches and the average female height was 65.6 ± 2.8 inches. The average male weight was 189.3 ± 22.6 pounds and the average female weight was 150.9 ± 32.4 pounds.

Table 2. Physical Characteristics, Class 14-02 Initial Survey (n=185)

Variable	Gender	Category	N (%)	Mean ± SD (Range)
BMI, modified CDC categories (kg/m²)	Males	≤ 24.9 (normal)	40 (26%)	26.7 ± 2.7 (20.8-34.4)
		25.0 to 27.5 (low-overweight)	62 (40%)	
		27.6 to 29.9 (high-overweight)	31 (20%)	
		≥ 30 (obese)	21 (14%)	
	Females	≤ 24.9 (normal)	22 (71%)	23.9 ± 2.5 (16.8-28.4)
		25.0 to 26.0 (low-overweight)	4 (13%)	
		26.1 to 29.9 (high-overweight)	5 (16%)	
		≥ 30 (obese)	0 (0%)	
Height (tertiles)	Males	≤69 inches	50 (33%)	70.5 ± 2.8 (65-79)
		70 to 71 inches	50 (33%)	
		≥ 72 inches	54 (35%)	
	Females	≤64 inches	10 (32%)	65.6 ± 2.8 (59-75)
		65 to 66 inches	9 (29%)	
		≥ 67 inches	12 (39%)	
Weight (tertiles)	Males	≤ 178 pounds	51 (33%)	189.3 ± 22.6 (130-270)
		179 to 196 pounds	55 (36%)	
		≥ 197 pounds	48 (31%)	
	Females	≤ 138 pounds	11 (36%)	150.9 ± 32.4 (113-300)
		139 to 152 pounds	10 (32%)	
		≥ 153 pounds	10 (32%)	

6.1.3 Physical Fitness: Performance on Most Recent APFT

Raw scores for respondents' most recent APFT are reported in Table 3. The average age of male students was 35.6 (±3.7) years and the average age for female students was 34.6 (±3.7) years. Males completed an average of 61 push-ups and females completed an average of 32 push-ups during the APFT (Table 3). Males and females both completed an average of 68 sit-ups during the APFT. Males ran the 2 mile run in 15.5 minutes on average and females ran the 2 mile run in 17.4 minutes on average.

Table 3. Army Physical Fitness Test (APFT) performance, Class 14-02 Initial Survey (n=185)

Variable	Gender	Category	N (%)	Mean ± SD
Push-ups (tertiles)	Males	≤ 53 repetitions	50 (33%)	61.5 ± 14.4
		54 to 70 repetitions	54 (36%)	
		≥ 71 repetitions	47 (31%)	
	Females	≤ 26 repetitions	10 (35%)	32.4 ± 9.8
		27 to 37 repetitions	10 (35%)	
		≥ 38 repetitions	9 (31%)	
Sit-ups (tertiles)	Males	≤ 64 repetitions	53 (35%)	68.4 ± 14.1
		65 to 75 repetitions	47 (31%)	
		≥ 76 repetitions	50 (33%)	
	Females	≤ 63 repetitions	10 (37%)	67.9 ± 16.8
		64 to 71 repetitions	8 (30%)	
		≥ 72 repetitions	9 (33%)	
2-Mile Run (tertiles)	Males	≤ 15:00 minutes and seconds	50 (34%)	15:5 ± 2.2
		15:01 to 16:17 minutes and seconds	51 (34%)	
		≥ 16:18 minutes and seconds	48 (32%)	
	Females	≤ 17:00 minutes and seconds	10 (37%)	17:4 ± 1.6
		17:01 to 18:40 minutes and seconds	8 (30%)	
		≥ 18:41 minutes and seconds	9 (33%)	

6.1.4 Tobacco Use

Only 3 percent of respondents were current smokers and 11 percent were smokeless tobacco users (Table 4). Very few (1 percent) used both cigarettes and smokeless tobacco.

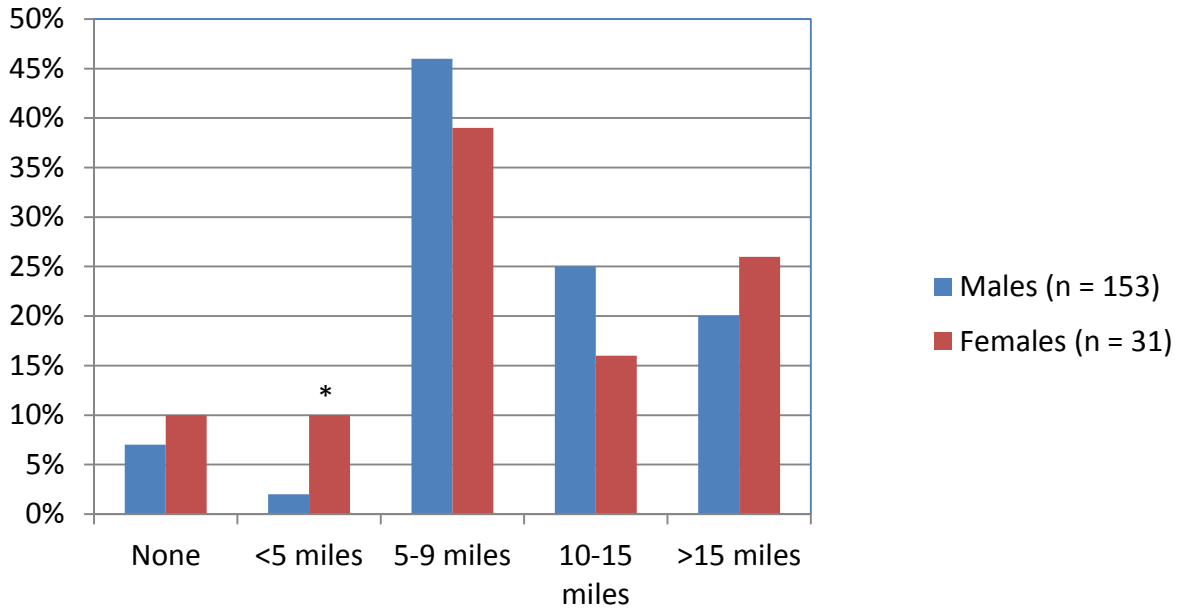
Appendices E and F provide summaries of additional survey responses to questions concerning tobacco use and dietary habits. Detailed injury information captured by the initial survey (for example, limited duty days, mechanism and activity associated with injury, permanent profiles, and injury impact) are presented in Appendix G.

Table 4. Tobacco use, Class 14-02 Initial Survey (n=185)

Variable	Response	n (%)
Current Smoker (defined as smoked 100 cigarettes in lifetime and at least one cigarette in the last 30 days)	Yes	6 (3%)
	No	179 (97%)
Former Smoker (n=24)	Yes, quit >1 year ago	23 (96%)
	Yes, quit <1 year ago	1 (4%)
Current Smokeless Tobacco User (defined as using smokeless tobacco in the last 30 days)	Yes	20 (11%)
	No	165 (89%)
Current Smokers Who Also Use Smokeless Tobacco	Yes	2 (1%)
	No	183 (99%)

6.1.5 Personal Physical Training Activities

Males reported completing 12.7 ± 8.9 miles (range: 4 to 70 miles) of weekly running for personal PT, on average, upon entry to CGSC. Females on average completed 12.1 ± 11.1 miles (range: 1 to 56 miles) of weekly running for personal PT. The majority of males (91 percent) and females (81 percent) completed 5 or more miles of running for personal PT per week (Figure 1). Twenty percent of males and 26 percent of females ran more than 15 miles per week on average.



*comparison, males vs. females: p<0.05

Figure 1. Average Distance Run per Week by Gender, Class 14-02 Initial Survey (n=185)

Over 80 percent (84 percent) of respondents performed aerobic endurance exercise other than running 1 or more times per week, 86 percent performed resistance training 1 or more times per week, and 58 percent performed sprint training 1 or more times per week (Table 5). Respondents also incorporated cross-training (15 percent) and Crossfit (14 percent); only 8 percent based their personal PT program on traditional Army physical training.

Table 5. Personal Physical Training Activities, Class 14-02 Initial Survey (n=185)

Variable	Category	N (%)
Frequency of Aerobic Endurance (not running)	Do not perform	30 (16%)
	1 to 2 times per week	93 (51%)
	≥ 3 times per week	61 (33%)
Frequency of Resistance Training	Do not perform	25 (14%)
	1 to 2 times per week	50 (27%)
	3 to 4 times per week	77 (42%)
	≥ 5 times per week	32 (17%)
Frequency of Sprint Training	Do not perform	76 (41%)
	1 to 2 times per week	100 (54%)
	≥ 3 times per week	8 (4%)
Basis of Personal Physical Training Program[a]	No specific program	88 (35%)
	Cross-training type	37 (15%)
	Crossfit	36 (14%)
	Other	32 (13%)
	Traditional Army PT	21 (8%)
	P90X	14 (6%)
	Insanity	10 (4%)
	Combatives	8 (3%)
	TRX	5 (2%)
	Do not perform	0

Note:
[a]Asked to select 'all that apply'.

6.1.6 Physical Therapy Encounters

Table 6 shows results from initial survey questions concerning the CGSC physical therapist. At the time of the survey, only 8 percent of respondents had visited the physical therapist and only 18 percent planned to visit the physical therapist.

Table 6. Physical Therapy Encounters, Class 14-02 Initial Survey (n=185)

Question	Response	N (%)
Have Seen CGSC Physical Therapist	Yes	14 (8%)
	No	171 (92%)
Plan to See CGSC Physical Therapist	Yes	34 (18%)
	No	151 (82%)

6.1.7 Injury Prevention Topic Interests

Injury prevention, fitness, or performance topics of interest to the incoming CGSC class (14-02) are listed in Table 7. Of the 185 respondents, 33 (18%) provided suggestions. Topics of interest included flexibility, shoulder injury & rehabilitation, and knee injury with strengthening & rehabilitation.

Table 7. Injury Prevention, Fitness, or Performance Topics of Interest, Class 14-02 Initial Survey (n=185)

Topic of Interest	n
Flexibility	5
Shoulder injury & rehab	5
Knee injury, strengthening & rehab	4
Lower back injury, pain & rehab	3
Weight control	2
Achilles tendon issues	1
Compressed ribs from MACP	1
Dealing with nerve pain	1
General injury prevention technique	1
High intensity training	1
Muscle strengthening	1
Olympic lifting	1
Overgrowth of joints/ligaments	1
Rebuilding strength after surgery	1
Reducing muscle spasms w/o meds	1
Running	1
Sprained ankle	1

6.2 Follow-up Survey Analysis: Physical Fitness, Health Behaviors, Physical Training, and Physical Therapy Use during CGSC

Changes in physical fitness and health behaviors in Class 14-02 during CGSC were assessed by comparing responses to the initial and follow-up surveys. Of the 296 U.S. Service Members originally enrolled in Class 14-02, 10 did not complete CGSC or deferred attendance and one student could not be verified, leaving 285 class members. Email addresses were obtained for all; only one was undeliverable. Of the 284 students, 55 (19 percent) responded to the follow-up survey (44 men, 10 women). A limited number of students completed both an initial and follow-up survey (n=38).

Responses from students who completed both surveys (n=38) were used to assess changes in physical fitness and health behaviors during CGSC. In this evaluation sample, most students were male (87 percent), age 35 to 39 (45 percent), Army (100 percent) and active duty (87 percent), and the greatest proportion (58 percent) were combat service support (Table 8).

Table 8. Demographics of Evaluation Sample (n=38)

Variable	Categories	Initial survey n (%)
Gender	Male	33 (87%)
	Female	5 (13%)
Age (years)	≤34	12 (32%)
	35 to 39	17 (45%)
(Mean: 36.3 ± 3.7;	≥40	7 (18%)
Range: 31-44)	Missing	2 (5%)
Service	Army	38 (100%)
Component	Active Duty	33 (87%)
	National Guard	2 (5%)
	Reserve	2 (5%)
	Other	1 (3%)
Military occupational specialty group	Combat arms	9 (24%)
	Combat support	7 (18%)
	Combat service support	22 (58%)

6.2.1 Physical Fitness before and during CGSC

A comparison of Class 14-02 self-reported APFT results with unit APFT records indicated a high correlation (Appendix H), consistent with what has been found in basic training and operational units (Jones SB 2007, Martin 2015). Self-reported APFT data on the evaluation sample are presented below.

Students in the evaluation sample improved their APFT performance while attending CGSC, with statistically significant improvements in cardiorespiratory endurance (2-mile run time) and muscle endurance (push-up repetitions) (Table 9). There were no statistically significant changes in body composition as measured by the proportion of students by CDC BMI category (p=0.96) (Table 10).

Analysis of Class 14-02 unit APFT records produced similar findings, with statistically significant improvements in run time, push-ups, and total APFT score between the initial and mid-point tests and no statistically significant changes observed for sit-ups or BMI (Appendix I).

Table 9. Comparison of APFT Performance, Evaluation sample (n=38)

Variable	n	Before CGSC (Initial survey) (mean±SD)	During CGSC (Follow-up survey) (mean±SD)	Absolute Difference	Paired t-test Initial vs. follow-up (p-value)
2 Mile Run (minutes and fraction of a minute)	36	15.63 ± 1.74	15.21 ± 1.57	-0.42	<0.01
Push-Ups (repetitions)	37	54.3 ± 16.3	60.3 ± 17.1	+6.0	<0.01
Sit-Ups (repetitions)	37	67.6 ± 12.7	69.9 ± 12.8	+2.3	0.16

Table 10. Comparison of BMI by CDC Classifications, Evaluation Sample (n=38)

Variable	Categories	Before CGSC (Initial survey) n (%)	During CGSC (Follow-up survey) n (%)	Chi-square, initial vs. follow-up
BMI (kg/m^2)-CDC classifications	<18.5 (Underweight) 18.5-24.9 (Normal) 25.0-29.9 (Overweight) ≥30 (Obese)	0 (0%) 11 (29%) 18 (47%) 9 (24%)	0 (0%) 10 (26%) 19 (50%) 9 (24%)	0.96
BMI (kg/m^2) Men	<18.5 (Underweight) 18.5-24.9 (Normal) 25.0-27.4 (Low Overweight) 27.5-29.9 (High Overweight) ≥30 (Obese)	0 7 (21%) 11 (33%) 6 (18%) 9 (27%)	0 6 (18%) 9 (27%) 9 (27%) 9 (27%)	0.88
BMI (kg/m^2) Women	<18.5 (Underweight) 18.5-24.9 (Normal) 25.0-26.0 (Low Overweight) 26.1-29.9 (High Overweight) ≥30 (Obese)	0 4 (80%) 1 (20%) 0 0	0 4 (80%) 1 (20%) 0 0	1.00

6.2.2 Tobacco Use and Personal Physical Training before and during CGSC

Based on this evaluation sample, there was no change in the proportion of cigarette smokers or smokeless tobacco users during CGSC (Table 11). With regard to personal PT, all students in the sample reported performing PT on their own time both before and during CGSC (100 percent). One borderline statistically significant change in personal PT activities was observed: prior to CGSC, 78% of students reported sprint training sessions 1-2 times per week, while during CGSC only 53% reported maintaining sprint training sessions 1-2 times per week in their personal PT program (p=0.06).

Table 11. Comparison of Tobacco Use and Personal Physical Training Activities, Evaluation sample (n=38)

Variable	Categories	Before CGSC (Initial survey) n (%)	During CGSC (Follow-up survey) n (%)	Chi-square, initial vs. follow-up
Cigarette use[a]	Yes No	0 38 (100%)	0 38 (100%)	1.00
Smokeless tobacco use[b]	Yes No	6 (16%) 32 (84%)	6 (16%) 32 (84%)	1.00
Personal PT				
Perform PT on own time	Yes No	38 (100%) 0	38 (100%) 0	1.00
Frequency of distance running	No distance running 1-2 times per week 3-4 times per week ≥5 times per week	3 (8%) 9 (24%) 20 (53%) 6 (16%)	1 (3%) 9 (24%) 26 (68%) 2 (5%)	0.29
How far run when perform distance running	1-2 miles per week 3-4 miles per week ≥5 miles per week	4 (11%) 26 (74%) 5 (14%)	4 (11%) 28 (76%) 5 (14%)	0.99
Total miles per week (calculated)	No distance running <5 miles per week 5-9 miles per week 10-19 miles per week ≥20 miles per week	3 (8%) 0 17 (45%) 15 (39%) 3 (8%)	1 (3%) 2 (5%) 14 (37%) 18 (47%) 3 (8%)	0.47
Frequency of aerobic endurance training that did NOT involve running	No aerobic endurance 1-2 time per week 3-4 times per week ≥5 times per week	3 (8%) 26 (68%) 7 (18%) 2 (5%)	5 (13%) 24 (63%) 7 (18%) 2 (5%)	0.90
Duration of aerobic endurance training that did NOT involve running	30 minutes or less per session 31-60 minutes per session 1 hour or more per session	14 (40%) 17 (49%) 4 (11%)	18 (55%) 14 (42%) 1 (3%)	0.28
Frequency of resistance training	No resistance training 1-2 times per week 3-4 times per week ≥5 times per week	1 (3%) 11 (29%) 19 (50%) 7 (18%)	2 (5%) 15 (39%) 16 (42%) 5 (13%)	0.67
Frequency of sprint or interval training	No sprint/interval running 1-2 times per week ≥3 times per week	7 (19%) 29 (78%) 1 (3%)	16 (44%) 19 (53%) 1 (3%)	**0.06**
Duration of resistance training	30 minutes or less per session 31-60 minutes per session 1 hour or more per session	13 (34%) 22 (58%) 3 (8%)	19 (50%) 17 (45%) 2 (5%)	0.37

Variable	Categories	Before CGSC (Initial survey) n (%)	During CGSC (Follow-up survey) n (%)	Chi-square, initial vs. follow-up
Personal PT program based on (multiple responses allowed)	Traditional Army PT	4 (8%)	11 (13%)	
	Cross-training type	5 (10%)	15 (18%)	
	TRX®	2 (4%)	4 (5%)	
	Power 90 Extreme®	4 (8%)	4 (5%)	
	Crossfit®	8 (16%)	11 (13%)	0.32
	Mission Essential Fitness[c]	1 (2%)	--	
	Insanity®	--	3 (4%)	
	Other	8 (16%)	13 (16%)	
	No Specific Program	18 (36%)	18 (22%)	

Notes:
[a]Cigarette Use was defined as an individual who had smoked 100 cigarettes in their lifetime and had smoked in the last 30 days.
[b]Smokeless Tobacco Use was defined as an individual who had used smokeless tobacco products in the last 30 days.

6.2.3 Physical Therapy Use during the CGSC

The follow-up survey contained a series of questions about the use of the CGSC physical therapist. A summary of responses for all follow-up surveys is below (Table 12). Among those who were injured, approximately half (52 percent) were referred to Physical Therapy and only 27 percent saw the CGSC physical therapist. Among all survey respondents, only about half (53 percent) were aware that a physical therapist was assigned specifically to serve CGSC students. Approximately half (55 percent) were aware of early morning physical therapy appointments offered by the CGSC physical therapist at the nearby Army Wellness Center, but few students (n=6) reported utilizing these appointments. If a physical therapist was co-located at the school, 77 percent reported they would be likely or very likely to take advantage of an injury prevention consultation or additional injury treatment.

Table 12. Use of Physical Therapist , Class 14-02 Follow-up Survey (n=55)

Variable	Categories	n (%)
Among those who were injured (n=21)		
Referred to physical therapy	Yes No	11 (52%) 10 (48%)
Seen by CGSC physical therapist	Yes No, seen by another physical therapist No, did not seek physical therapy treatment	3 (27%) 7 (64%) 1 (9%)
Among all survey respondents (n=55)		
Aware that a physical therapist was assigned to consult with & treat CGSC students	Yes No Missing	29 (53%) 24 (44**%**) 2 (4%)
Aware of early morning physical therapy appointments at the Army Wellness Center (AWC)	Yes No Missing	30 (55**%**) 23 (42%) 2 (4%)
If yes, did you utilize the physical therapy appointments at AWC?	Yes No Missing	6 (20%) 23 (77%) 1 (3%)
If a physical therapist was co-located at the school, how likely would you have been to take advantage of an injury prevention consultations or additional injury treatment	Very Likely Likely Neutral Unlikely Very Unlikely Missing	24 (44**%**) 18 (33%) 4 (7%) 1 (2%) 6 (11%) 2 (4%)

6.3 Medical Records Analysis: Injury Incidence, Injury Types, and Clinic Use

To enable the most complete comparison of injuries possible, injury analysis was not limited to the evaluation sample (i.e., those who took both surveys). A roster obtained from ATRRS indicated that 292 U.S. Service Members were enrolled in the comparison class, Class 13-02, and the 14-02 class roster obtained by the CGSC physical therapist in January 2014 indicated that 296 U.S. Service Members were enrolled in Class 14-02. Medical records were obtained for a total of 284 (97%) students in Class 13-02 and 293 (99%) students in Class 14-02.

Demographics of students with available electronic medical records for both classes are shown in Table 13. The classes were similar with regard to the distributions of gender, age, component, injuries during CGSC, and proportions passing the APFT (based on unit records). However, the prior class had fewer Army students (86 percent vs. 99 percent, Class 63 and 64, respectively) and a lower proportion of students injured prior to CGSC (46 percent vs.56 percent, Class 13-02 and 14-02, respectively).

Table 13. Demographics from Electronic Medical Records, Class 14-02 and 13-02

Variable	Categories	Class 1302 (n=284) n (%)	Class 1402 (n=293) n (%)	Chi-square p-value
Gender	Male	248 (87%)	245 (84%)	0.21
	Female	36 (13%)	48 (16%)	
Age	≤29	1 (<1%)	0	0.14
	30-34	113 (40%)	133 (45%)	
	35-39	111 (39%)	91 (31%)	
	≥40	59 (21%)	68 (23%)	
Service	Air Force	19 (7%)	1 (<1%)	<0.01
	Army	243 (86%)	287 (99%)	
	Marines	0 (0%)	2 (1%)	
	Navy	21(7%)	1 (<1%)	
	Missing	1	1	
Component	Active Duty	260 (91%)	267 (91%)	0.96
	National Guard/Reserve	24 (9%)	25 (9%)	
Injured prior to the CGSC	Yes	124 (46%)	161 (56%)	0.01
	No	148 (54%)	126 (44%)	
Injured during the CGSC	Yes	152 (53%)	165 (56%)	0.50
	No	132 (47%)	128 (44%)	
APFT Pass[a] (mid-point)	Yes	207 (99%)	246 (100%)	0.28
	No	1 (1%)	0	

Note:
[a]Unit APFT data available for only a portion of those with a medical record

6.3.1 Cumulative Injury Incidence

On average, in the class with the physical therapist (Class 14-02), 5.63 students were injured per 100 students per month. Lower extremity overuse injuries represented 70 percent of all injuries, with a rate of 3.92 per 100 students per month. For Class 14-02, the cumulative injury incidence was not statistically significantly different from the proportion of the class injured 1 year prior to CGSC attendance (56.1 vs. 56.3 percent, p=0.93).

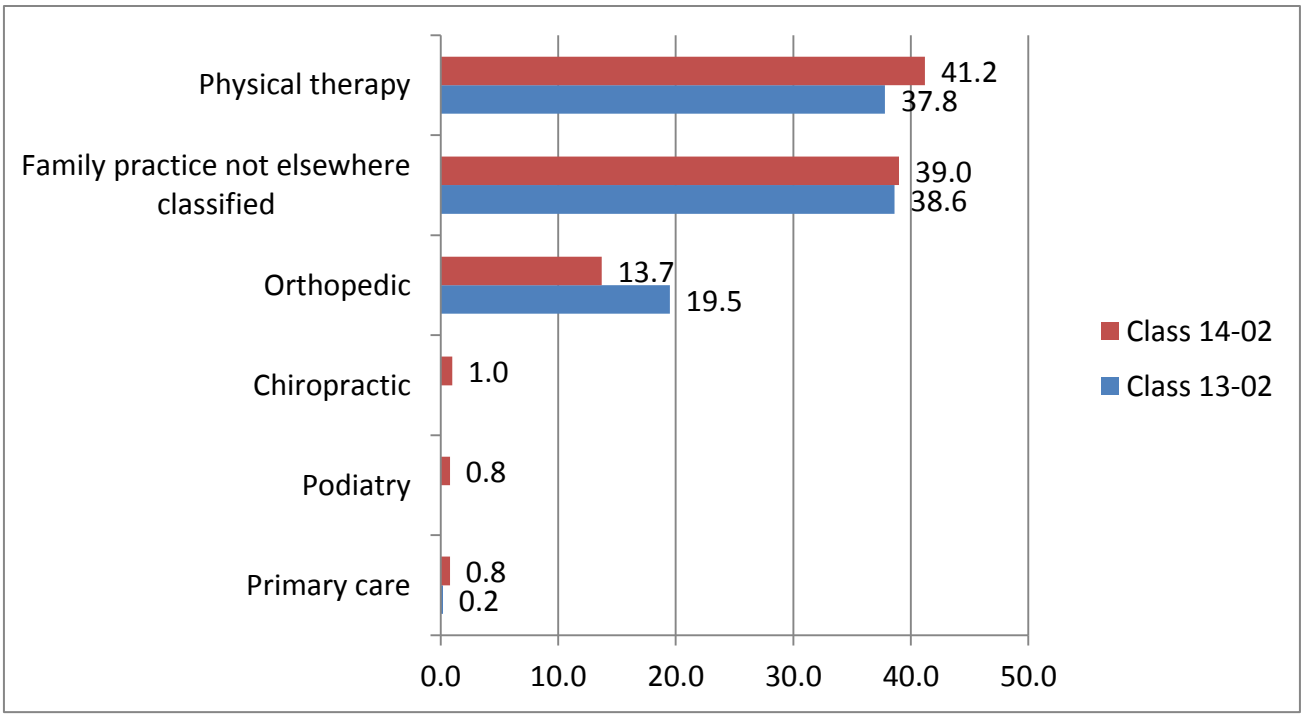
Table 14 presents the injury incidence for Class 14-02 and a comparison (prior) class without a physical therapist (Class 13-02). The proportion injured during CGSC for Class 14-02 was not statistically different from the proportion in Class 13-02 (56.3 vs. 53.5 percent, p=0.50). The incidence of lower extremity injury was also not significantly different between classes (39.2 vs. 33.5 percent, p=0.15). Injury incidence prior to CGSC was statistically higher for the class with the physical therapist (56.1 vs. 45.6 percent, p=0.01).

Table 14. Comparison of Injury Incidence, Class 14-02 and 13-02

Class and injury definition	Cumulative injury incidence, Class 14-02 with physical therapist (n=293, Class 1402)	Injury incidence, Class 13-02 without physical therapist (n=284, Class 1302)	Risk ratio	p-value
During CGSC, Comprehensive Injury Index (CII)	56.3	53.5	1.06 (0.90, 1.24)	0.50
During CGSC, Installation Injury Index (III)	51.5	47.5	1.08 (0.92, 1.28)	0.34
During CGSC, Lower extremity overuse injury (TRII)	39.2	33.5	1.17 (0.94, 1.46)	0.15
1 year prior to the CGSC (CII)	56.1	45.6	1.23 (1.04, 1.45)	0.01

6.3.2 Clinic Use

Between both classes, over 90 percent of injuries were treated by Physical Therapy, Family Practice (not otherwise specified), and Orthopedics (Figure 2). A greater proportion of injuries in Class 14-02 were treated by Physical Therapy compared to the prior class (41.2 vs. 37.8 percent, p=0.04). In the prior class, a greater proportion of injuries were seen by the Orthopedic Clinic (19.5 vs. 13.7 percent, p≤0.001).



Notes: n=1,427 injury visits during CGSC among students in Class 14-02; n=1,165 injury visits during CGSC among students in Class 13-02.

Figure 2. Proportion of Injuries Treated by Clinic, Class 14-02 and 13-02

6.3.3 Injury Types

Over half (57 percent, n=822) of injury visits for Class 14-02 could be classified in the Barell matrix or injury-related musculoskeletal matrix. Of the visits that could not be classified in a matrix (n=605), the majority (86 percent) contained a V-code in the primary diagnosis position.

Table 15 indicates that the leading traumatic injuries sustained during CGSC for Class 14-02 were sprains and strains (52.5 percent) and fractures (20.3 percent). Leading body regions affected were the lower extremity (32.2 percent) and upper extremity (39.0 percent).

Table 16 shows that the leading injury-related musculoskeletal diagnoses during CGSC for Class 14-02 were related to inflammation and pain (62.2 percent). Leading body regions affected by injury-related musculoskeletal conditions were the spine and back (54.1 percent) and lower extremity (27.0 percent).

Appendix J provides additional summaries of injuries obtained from medical records data for both Class 14-02 and 13-02, before and during CGSC.

Table 15. Injury Visits by Diagnosis and Body Region (Barell Matrix) for Acute Injuries during CGSC, Class 14-02[a]

			Fracture	Dislocation	Sprains/ Strains	Internal	Open Wound	Amputations	Blood Vessel	Contusion/ Superficial	Crush	Burns	Nerves	Unspecified	System-wide & Late Effects	Total	%	Percent by Body Region
Head and Neck	Traumatic Brain Injury (TBI)	Type 1 TBI	0			0							0			0	0	0
		Type 2 TBI	0			0										0	0	
		Type 3 TBI	0													0	0	
	Other Head, Face, Neck	Other head					2					0	0	1		3	2.5	7.6
		Face	0	0	0		1					0				1	0.8	
		Eye					0			0		0	0			0	0	
		Neck	0		0		0				0	0	0			0	0	
		Head, Face, Neck Unspec.							0	2	0	0	0	3		5	4.2	
Spine and Back	Spinal Cord (SCI)	Cervical SCI	0			0										0	0	0
		Thoracic/ Dorsal SCI	0			0										0	0	
		Lumbar SCI	0			0										0	0	
		Sacrum Coccyx SCI	0			0										0	0	
		Spine, Back Unspec. SCI	0			0										0	0	
	Vertebral Column (VCI)	Cervical VCI	0	0	4											4	3.4	5.9
		Thoracic/ Dorsal VCI	0	0	0											0	0	
		Lumbar VCI	0	0	3											3	2.5	
		Sacrum Coccyx VCI	0	0	0											0	0	
		Spine, Back Unspec. VCI	0	0												0	0	
Torso	Torso	Chest (thorax)	0	0	0	0	0		0	0	0	0	0			0	0	2.5
		Abdomen				0	0		0	0		0	0			0	0	
		Pelvis, Urogenital	0	0	1	0	0		0	0	0	0	0			1	0.8	
		Trunk	0				0			2	0	0	0	0		2	1.7	

			Fracture	Dislocation	Sprains/ Strains	Internal	Open Wound	Amputations	Blood Vessel	Contusion/ Superficial	Crush	Burns	Nerves	Unspecified	System-wide & Late Effects	Total	%	Percent by Body Region
Torso	Torso (cont'd)	Back, Buttock			0		0			0	0	0				0	0	
Extremities	Upper	Shoulder, Upper Arm	0	0	13		0	0		0	0	0		1		14	11.9	39.0
		Forearm, Elbow	0	0	0		0	0		0	0	0				0	0	
		Wrist, Hand, Fingers	23	0	5		2	0		1	0	0		1		32	27.1	
		Other & Unspec.	0				0	0	0	0	0	0	0	0		0	0	
	Lower	Hip	0	0	6					0	0					6	5.1	32.2
		Upper leg, Thigh	0					0		0	0	0				0	0	
		Knee	0	1	0					0	0	0				1	0.8	
		Lower leg, Ankle	1	0	23			0		0	0	0				24	20.3	
		Foot, toes	0	0	3		0	0		0	0	0				3	2.5	
		Other & Unspec.	0		0		1	0	0	1	0	0		2		4	3.4	
Unclass. by Site	Other, Unspecified	Other/ Multiple	0						0			0	0			0	0	7.6
		Unspec. Site	0	1	4	0	0		0	4	0	0	0	0		9	7.6	
	System-wide & late effects														6	6	5.1	5.1
		Total	24	2	62	0	6	0	0	10	0	0	0	8	6	118		
		Percent	20.3	1.7	52.5	0	5.1	0	0	8.5	0	0	0	6.8	5.1		100	100

Notes:
[a]first diagnoses only

Table 16. Injury Visits by Diagnosis and Body Region for Injury-related Musculoskeletal Injuries, Class 14-02[a]

			Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological	Stress Fracture	Sprains/ Strains/ Rupture	Dislocation	Total	%	Percent by Body Region
Spine and Back	Vertebral Column (VCI)	Cervical VCI	56	3	13				72	10.2	54.1
		Thoracic/Dorsal VCI		6	44				50	7.1	
		Lumbar VCI	0	8	161				169	24.0	
		Sacrum Coccyx VCI	35						35	5.0	
		Spine, Back Unspecified VCI	51	3	1	0			55	7.8	
Extremities	Upper	Shoulder	70	8			0	0	78	11.1	15.5
		Upper Arm, Elbow	12	0		0		0	12	1.7	
		Forearm, Wrist	14	0		0		0	14	2.0	
		Hand	5	0			0	0	5	0.7	
	Lower	Pelvis, Hip, Thigh	64	0		0	0	0	64	9.1	27.0
		Lower leg, Knee	61	4		0	6	0	71	10.1	
		Ankle, Foot	49	6		0	0	0	55	7.8	
Unclass. by Site	Other, Unspecified	Other specified/Multiple	2	0		1	0	0	3	0.4	3.4
		Unspecified Site	19	0	2	0	0	0	21	3.0	
		Total	438	38	221	1	6	0	704		
		Percent	62.2	5.4	31.4	0.1	0.9	0.0		100.0	100.0

Note:
[a]first diagnoses only

6.4 Risk Factors for Injury during the CGSC

Table 17 shows the associations of demographic, physical fitness, prior injury, and personal PT activities with the risk for one or more injury visits during CGSC. Data sources included the electronic medical records (demographics and injury) and the initial survey (health risk behaviors and APFT results prior to the CGSC). Potential risk factors for injury during CGSC ($p \leq 0.10$) included: age, Military Occupational Specialty (MOS), and injury in the year prior to CGSC. Not incorporating other aerobic endurance activities (other than running) appeared to be protective against injury during CGSC. A backward-stepping multivariate logistic regression indicated that MOS and injury in the year prior to CGSC were associated with injury risk during CGSC. The final multivariable model (Table 18) controlled for known injury risk factors (age and gender) and a demographic factor associated with injury in this population (MOS). The final model found students with an injury in the year prior to CGSC were nearly 4 times more likely to be seen for an injury during CGSC.

Table 19 shows the association of demographic, physical fitness, prior injury, and personal PT activities with the risk for one or more lower extremity (LE) overuse injury visit during CGSC. Univariate models suggested the following factors were potentially associated with injury risk during CGSC ($p \leq 0.10$): gender, MOS, body fat, performance on the APFT sit-up event, performance on the APFT push-up event, and LE injury in the year prior to CGSC. A backward-stepping multivariate logistic regression indicated that MOS and injury in the year prior to CGSC were associated with injury risk during CGSC. The final multivariable model (Table 18) controlled for known injury risk factors (age and gender) and a demographic factor associated with injury in this population (MOS). As seen with any injury, students with a LE overuse injury in the year prior to CGSC were 5 times more likely to be seen for a LE overuse injury during CGSC.

Table 17. Association of Demographic, Physical Fitness, and Physical Activities with Injury: Univariate Logistic Regression Results, Class 14-02 (Initial Survey with Medical Records, n=182)

Variable	Categories	N	Injured (%)	Odds ratio (95%CI)	p-value overall
Gender	Male	152	50%	1.00	0.19
	Female	30	63%	1.73 (0.77-3.87; 0.19)	
Age (years)	≤34	92	53%	1.64 (0.84-3.20; 0.15)	**0.08**
	35-39	56	41%	1.00	
	≥40	30	67%	**2.87 (1.14-7.25; 0.03)**	
Component	Active Duty	167	52%	1.00	0.99
	National Guard	6	50%	0.92 (0.18-4.69; 0.92)	
	Army Reserve	8	50%	0.92 (0.22-3.80; 0.91)	
	Other	1	100%		
MOS Group	Combat Arms	73	52%	1.00	**0.04**
	Combat Support	43	37%	0.55 (0.25-1.18; 0.12)	
	Combat Service Support	66	62%	1.51 (0.77-2.97; 0.23)	
Current cigarette smoking	Yes	5	53%	0.60 (0.10-3.69; 0.58)	0.58
	No	177	40%	1.00	
Current smokeless tobacco use	Yes	18	44%	0.85 (0.27-2.65; 0.78)	0.78
	No	164	53%	1.00	
Body fat percentage (tertiles)	21.5 or less	59	51%	1.26 (0.62-2.60; 0.52)	0.29
	21.51 to 24.75	60	45%	1.00	
	24.76 or more	59	59%	1.87 (0.86-3.69; 0.12)	
APFT 2 mile run time (tertiles)	Fastest (15.25 or less minutes)	59	51%	1.00	0.99
	Moderate (15.26 to 16.45 minutes)	57	51%	1.00 (0.48-2.07; 0.99)	
	Slowest (16.46 or more minutes)	58	50%	0.97 (0.47-2.00; 0.93)	
APFT sit-ups (tertiles)	Lowest (64 or less)	63	46%	0.72 (0.35-1.47; 0.36)	0.66
	Moderate (65 to 75)	55	51%	0.87 (0.41-1.83; 0.71)	
	Highest (76 or more)	57	54%	1.00	
APFT push-ups (tertiles)	Lowest (50 or less)	71	56%	1.43 (0.71-2.86; 0.31)	0.53
	Moderate (51 to 65)	48	48%	1.02 (0.48-2.18; 0.96)	
	Highest (66 or more)	59	48%	1.00	
Injury 1 year prior to CGSC	Yes	94	66%	**3.25 (1.76-6.02; <0.01)**	**<0.01**
	No	83	37%	1.00	

Note: Variables considered for multivariable model (p≤0.10) in bold.

Variable	Categories	N	Injured (%)	Odds ratio (95%CI; p-value)	p-value overall
Distance run for personal PT	≤ 8 miles per week 9-12 13+	51 68 49	57% 46% 49%	1.00 0.64 (0.31-1.32; 0.23) 0.73 (0.33-1.60; 0.43)	0.47
Frequency of other aerobic endurance training for personal PT	Do not perform ≥ 1 time per week	30 151	37% 55%	**0.47 (0.21-1.07; 0.07)** 1.00	**0.07**
Frequency of resistance training for personal PT	Do not perform ≥ 1 time per week	25 156	60% 51%	1.46 (0.62-3.45; 0.39) 1.00	0.39
Frequency of sprint training for personal PT	Do not perform ≥ 1 time per week	74 107	57% 49%	1.39 (0.77-2.52; 0.28) 1.00	0.28

Table 18. Risk Factors for Injury: Multivariable Logistic Regression Results, Class 14-02

Variable	Categories	Odds ratio (95% CI)	p-value
Injury 1 year prior to CGSC	Yes No	**3.72 (1.89-7.33)** 1.00	**<0.01**
MOS Group	Combat Arms Combat Support Combat Service Support	1.00 **0.42 (0.18-0.99)** 1.41 (0.65-3.10)	 **0.05** 0.39
Age (years)	≤34 35-39 ≥40	1.67 (0.79-3.50) 1.00 2.06 (0.73-5.81)	0.18 0.17
Gender	Male Female	1.00 0.97 (0.37-2.53)	 0.95

*Variables included in model: Age, gender, MOS group, injury 1 year prior to CGSC
Note: Statistically significant results (p≤0.05) in bold.

Table 19. Association of Demographic, Physical Fitness, and Physical Activities with Lower Extremity Overuse Injury: Univariate Logistic Regression Results, Class 14-02 (Initial survey with Medical Records, n=182)

Variable	Categories	N	Injured (%)	Odds ratio (95%CI)	p-value overall
Gender	Male	152	34%	1.00	**0.09**
	Female	30	50%	**1.98 (0.90-4.37; 0.09)**	
Age (years)	≤34	92	36%	1.09 (0.54-2.19; 0.81)	0.48
	35-39	56	34%	1.00	
	≥40	30	47%	1.70 (0.69-4.22; 0.25)	
Component	Active Duty	167	37%	1.00	0.50
	National Guard	6	17%	0.34 (0.04-2.97; 0.31)	
	Army Reserve	8	25%	0.57 (0.11-2.88; 0.49)	
	Other	1	100%		
MOS Group	Combat Arms	73	34%	1.00	**0.04**
	Combat Support	43	23%	0.58 (0.25-1.37; 0.21)	
	Combat Service Support	66	47%	1.70 (0.86-3.37; 0.21)	
Current cigarette smoking	Yes	5	40%	1.18 (0.19-7.23; 0.86)	0.86
	No	177	36%	1.00	
Current smokeless tobacco use	Yes	18	22%	0.55 (0.15-2.03; 0.37)	0.37
	No	164	38%	1.00	
Body fat percentage (tertiles)	21.5 or less	59	32%	1.20 (0.55-2.63; 0.65)	**0.03**
	21.51 to 24.75	60	28%	1.00	
	24.76 or more	59	51%	**2.62 (1.23-5.59; 0.01)**	
APFT 2 mile run time (tertiles)	Fastest (15.25 or less minutes)	59	29%	1.00	0.60
	Moderate (15.26 to 16.45 minutes)	57	37%	1.44 (0.66-3.14; 0.36)	
	Slowest (16.46 or more minutes)	58	36%	1.40 (0.65-3.05; 0.39)	
APFT sit-ups (tertiles)	Lowest (64 or less)	63	37%	0.85 (0.41-1.78; 0.67)	0.15
	Moderate (65 to 75)	55	24%	**0.46 (0.20-1.04; 0.06)**	
	Highest (76 or more)	57	40%	1.00	
APFT push-ups (tertiles)	Lowest (50 or less)	71	45%	**2.64 (1.23-5.64; 0.01)**	**0.04**
	Moderate (51 to 65)	48	33%	1.61 (0.69-3.75; 0.27)	
	Highest (66 or more)	59	24%	1.00	
LE Injury 1 year prior to CGSC	Yes	63	59%	**4.59 (2.37-8.89;<0.01)**	**<0.01**
	No	114	24%	1.00	

Note: Variables considered for multivariable model (p≤0.10) in bold.

Variable	Categories	N	Injured (%)	Odds ratio (95%CI)	p-value overall
Distance run for personal PT	≤ 8 miles per week 9-12 13+	51 68 49	41% 32% 31%	1.00 0.68 (0.32-1.45; 0.32) 0.63 (0.28-1.44; 0.27)	0.48
Frequency of other aerobic endurance training for personal PT	Do not perform ≥ 1 time per week	30 151	30% 37%	0.73 (0.31-1.70; 0.46) 1.00	0.46
Frequency of resistance training for personal PT	Do not perform ≥ 1 time per week	25 156	40% 35%	1.22 (0.52-2.91; 0.65) 1.00	0.65
Frequency of sprint training for personal PT	Do not perform ≥ 1 time per week	74 107	39% 34%	1.27 (0.69-2.35; 0.45) 1.00	0.45

Table 20. Risk Factors for Lower Extremity Overuse Injury: Multivariable Logistic Regression Results, Class 14-02

Variable	Categories	Odds ratio (95% CI)	p-value
Lower extremity injury 1 year prior to CGSC	Yes No	**5.34 (2.53-10.99)** 1.00	**<0.01**
Age (years)	≤34 35-39 ≥40	1.04 (0.47-2.30) 1.00 1.00 (0.35-2.84)	0.91 0.99
Gender	Male Female	1.00 1.52 (0.58-3.97)	 0.39
MOS Group	Combat Arms Combat Support Combat Service Support	1.00 0.45 (0.17-1.19) 1.96 (0.87-4.40)	 0.11 0.11

*Variables included in model: Age, gender, lower extremity injury 1 year prior to CGSC
Note: Statistically significant results (p≤0.05) in bold.

7 Discussion

In June 2013, a physical therapist was assigned to serve the CGSC students and provide injury treatment and injury prevention education to CGSC students. Using data from students who attended CGSC from February to December 2014 (Class 14-02), this evaluation sought to (1) evaluate the effects of the physical therapist on injuries and physical fitness of CGSC students and (2) assess risk factors for injury among CGSC students.

7.1 Initial Survey Findings

The majority of respondents to the initial Class 14-02 survey were male and active duty, similar to the Sergeants Major Course (APHC (Prov) 2015) and other Army populations such as infantry brigade combat teams (Grier 2013; USAPHC 2014). This population is unique; however, given their selection for CGSC, their average age was 36 years old, and 99 percent held a rank of either O3 or O4. Physical fitness is a metric for acceptance into the program, therefore average push-up, sit-up, and run time APFT performance was well above passing (60 points for each event) for the 32 to 36 year old age group. Eleven percent of CGSC students were classified as 'obese' based on CDC BMI classification standards (BMI of 30.0 or higher), a level consistent with what has been observed at the Sergeants Major Course (12 percent) (APHC (Prov) 2015), infantry brigade combat teams (13 percent) (Grier 2013; USAPHC 2014), and among active duty Army Soldiers over 20 years of age (13.6 percent) (Bray et al., 2009).

Regarding health behaviors, only 3 percent were current smokers upon entry to CGSC, below the average proportion (34 percent) of active duty Army Soldiers who smoke cigarettes (Bray et al., 2009) and prior reports of 9 percent smokers at the Sergeants Major Course (APHC (Prov) 2015) and 1 percent smokers at the Army War College (USACHPPM 1999). However, 11 percent reported smokeless tobacco use. This percentage is lower than the 16 percent reported among active duty Army Soldiers (Bray et al., 2009) and similar to the 12 percent reported among students in the Sergeants Major Course (APHC (Prov) 2015). Most CGSC students had a robust personal physical training program upon entry to CGSC, with 89 percent reporting running 5 or more miles per week, 84 percent performing other aerobic endurance training one or more times per week, 86 percent incorporating resistance training one or more times per week, and 58 percent conducting sprint training one or more times per week.

7.2 Injuries during Command and General Staff College

Due to logistical and administrative challenges, few responses to the follow-up survey were received, thus limiting the information obtained on injuries during CGSC. However, medical record data for the class were summarized to provide insight into injury types treated during CGSC and body regions affected.

Leading injury types receiving treatment in the class with a physical therapist (Class 14-02) were sprains/strains (52.5 percent of acute injuries) and pain (62.2 percent of overuse musculoskeletal conditions). This was similar to leading injury types observed among all active duty Army Soldiers (sprain/strain 46 percent of acute injuries; pain 87 percent of primarily overuse musculoskeletal conditions) as well as in specific populations such as the 2013 Sergeants Major Course (sprain/strain 51 percent of acute injuries; pain 67 percent of musculoskeletal conditions), 1995 Sergeants Major Course (sprain/strain 36 percent and pain 30 percent of all injuries), and in an infantry brigade combat team (sprain/strain 47 percent and pain 15 percent of all injuries) (APHC (Prov) 2015; USAPHC 2014; Cosio-Lima et al. 2013; Marshall et al 2013).

Leading body regions for acute injuries in Class 14-02 are the same as leading body regions among all active duty Army Soldiers (Marshall et al. 2013), with leading regions affected being the lower extremity and upper extremity. However, leading body regions associated with injury-related musculoskeletal conditions (largely overuse injuries) for Class 14-02 were spine and back (54 percent) and lower extremity (27 percent), compared to spine and back (34 percent) and lower extremity (44 percent) among all active duty Army. Among 1999 Army War College students, lower extremity injury was most common body region injured (USACHPPM 1999). However, among 2013 Sergeants Major Course students, spine and back was also the leading body region associated with injury-related musculoskeletal conditions, followed by the lower extremity (APHC (Prov) 2015). This is in consonance with reports citing a high proportion of low back injuries among Soldiers in deployed environments (Cohen et al. 2005; Roy 2012; Rhon 2010). Although the survey did not capture deployment information, as of 2011 almost 73 percent of active component Soldiers had deployed (Baiocchi 2013).

7.3 Changes in Physical Fitness, Physical Training, and Injury

The ability to detect changes in physical fitness, tobacco use, and physical training during CGSC was also limited by the low follow-up survey response. However, among those who responded to both surveys, it appeared that the CGSC students were able to maintain their body composition, cardiorespiratory endurance, and muscle endurance despite being in a school environment with classroom activities that are inherently sedentary. APFT performance on the run and push-up events improved while attending CGSC, while BMI did not change. The same results were found with a larger sample of unit APFT records that assessed changes between initial and midpoint APFT measures. Tobacco use also did not change.

With regard to physical fitness activities, changes were not observed in distance running, other aerobic endurance training, resistance training, and use of high intensity interval training programs. Frequency and duration of these activities were of interest, given that high running mileage is associated with higher injury risk (Koplan et al. 1982; Fields 2011) and concerns about potential adverse effects of high intensity interval training in Army populations (Bergeron et al. 2011; Knapik 2015). Neither high running mileage nor significant amounts of high intensity interval training appear to be an issue in this population. Another positive observation was that over 80 percent of CGSC students included resistance training as part of their personal PT program upon arrival to CGSC. Studies have indicated that training programs incorporating both resistance and endurance training result in higher strength and aerobic performance than endurance training alone (Wilson et al. 2012; Grier et al. 2015).

The frequency of sprint training was lower during CGSC attendance however, potentially due to a lack of time and/or opportunity to conduct such training. The reduction in sprint or interval training suggests that CGSC students might benefit from additional instruction on the advantages and methods for incorporating this component of Army Physical Readiness Training (PRT) into their personal PT program. Sprint and interval training are components of PRT intended to facilitate cross-training and reduce risk of overtraining (DA 2012), and have been shown to improve aerobic endurance (Burgomaster et al. 2005).

Analysis of injury-related medical record data showed an injury rate in this CGSC class (5.6/100 students/month) that was lower than rates of injuries seen among 2013 Sergeants Major Course students (6.95/100 students/month) and investigations of Army War College students conducted in 1999 and 2000 (7.3 injuries/100 students/month and 6.4 injuries/100 students/month, 1999 and 2000, respectively), during which time the APFRI program was active at the War College and injuries due to intramural sports were of particular concern (APHC (Prov) 2015; Knapik et al. 2002). A study of injuries and illnesses among the Sergeants Major Course 1995 class reported 5.2

injuries/100 students/month (Cosio-Lima et al. 2013), a rate lower than Class 14-02. However, the Cosio-Lima study reported data only from injuries that occurred during physical fitness training.

Further analysis of injury-related medical record data did not detect changes in injury incidence (i.e., injury care-seeking behavior) during CGSC attendance. In Class 14-02, the class to which a physical therapist was assigned, injury incidence during CGSC did not differ from injury incidence prior to CGSC (56 vs. 56 percent). Injury incidence for this class also did not differ significantly from a prior class, Class 13-02 (56 vs. 54 percent, p=0.50). It was expected that the presence of a physical therapist might increase injury incidence, as seen at the Sergeants Major Course (SMC), where a higher lower extremity overuse injury incidence as assessed by medical visits during the SMC was observed for the class with a physical therapist compared to a prior class (57 vs. 50 percent, p=0.02) (APHC (Prov) 2015). Distributions of key injury risk factors (age, gender, APFT pass rate, and injury incidence prior to the SMC) did not differ between the two classes, therefore the higher incidence may have been a reflection of improved access and use of available specialized injury care.

Early treatment of injuries is a primary goal of programs that embed a physical therapist within a unit. A study conducted using Military Health System data showed that early referral to physical therapy for management of low back pain (within 14 days of the first visit for care) resulted in lower utilization of advanced imaging, lumbar spinal injections, lumbar spine surgery, and use of opioids, and as a result substantial cost savings and enhanced patient well-being (Childs et al. 2015). Studies looking at Medicare and Medicaid data and a national database of employer-sponsored health plans also showed lower risk of surgery, lumbar spinal injections, and opioid use with early access to physical therapy for management of low back pain (Gellhorn et al. 2012; Fritz et al. 2012). One quarter (24 percent) of all musculoskeletal conditions in Class 14-02 were associated with the lower back, indicating this is a commonly injured body region in this population. Enhanced access to physical therapy care during CGSC may facilitate early referral for new back pain incidents and reduce the number of subsequent medical procedures.

7.4 Physical Therapy Use

Despite a lack of demonstrated short-term impact on injuries and physical fitness, there were lessons learned about the program. Clinic use data indicated that 41 percent of injuries were treated by physical therapy in Class 14-02, suggesting that physical therapy services were being utilized. Despite this, only 27 percent of those referred to physical therapy were seen by the CGSC physical therapist. Of all follow-up survey respondents, only 53 percent were aware that a physical therapist had been assigned to Munson Army Health Center to consult with and treat CGSC students. Input from the CGSC physical therapist cited the following barriers to contact with CGSC students:

(1) Opportunities to interact with students, such as routine unit physical training or injury prevention classes offered as part of the CGSC curriculum, were not available.

(2) The physical therapist's clinic and office space was not located near the classroom facilities.

(3) Formal or informal contact with CGSC leadership was not established.

(4) The appointment scheduling system at Munson Army Health Center did not allow the CGSC physical therapist to limit appointment slots to students only. As a result, his time could not be dedicated to students; appointments were scheduled and he was utilized like all other physical therapists in the clinic.

The potential value of co-locating the physical therapist with students was evident from survey responses that showed 77 percent of follow-up respondents would have taken advantage of an injury prevention consultation or additional injury treatment if a physical therapist was co-located at the school. At the SMC, 46 percent of those who visited the SMC physical therapist said they would not have sought care if the physical therapist was not co-located with the students (APHC (Prov) 2015). Close proximity not only enhances access to care for the students, but would also facilitate contact with school administration and faculty. In a systematic review of workplace-based return-to-work interventions, strong evidence existed in support of interventions involving contact between healthcare providers and the workplace (Franche et al. 2005). For example, policies and programs that establish a formal framework for interaction between healthcare providers and the employer with regard to low back pain management have demonstrated favorable outcomes such as fewer days on sick leave, stable health status, and maintenance of ability to work 1-year post-intervention (Loisel et al. 2003; Karjalainen et al. 2003). In addition, a Cochrane review of back schools administered by medical providers indicated that they were effective for those with chronic or recurrent low back pain if linked with the workplace (Heymans et al. 2005). A review of multidisciplinary interventions addressing back pain showed improvement in return to work with interventions that included comprehensive occupational health care and a work site visit by a physical therapist or ergonomist (Karjalainen et al. 2001). A second study supported the effectiveness of a work site visit by specialists who provided an examination and opportunity for questions, discussed working conditions, and recommended specific evidence-based exercises to restore function. Among persons who received the intervention, daily pain was less common, satisfaction was higher, and sick leave use was lower (Karjalainen et al. 2003). This evidence suggests that establishing links between healthcare and the workplace will improve injury and disability outcomes.

Appointment times were offered at the nearby Army Wellness Center prior to the start of morning classes, but only 55 percent were aware of these appointments. Of those who were aware of the appointments, very few (n=6) utilized them. In the future, a needs assessment of desired appointment times and locations may assist in improving utilization. In addition, formal and/or informal contact with CGSC leadership and coordination to inform students of the availability of the CGSC physical therapist would help improve utilization. Establishment of informal relationships with leadership and students was cited as a factor contributing to the utilization of the physical therapist at the Sergeants Major Academy and also led to an invitation for the physical therapist to attend scheduled leadership meetings and the establishment of a train-the-trainer course for cadre, providing injury prevention and injury rehabilitation management education currently lacking in Army leadership schools (APHC (Prov) 2015). Focus groups of Soldiers and Leaders have noted a desire for more information on managing injured Soldiers, PT for profiled Soldiers, and effective implementation of Army PRT (USAPHC 2013). The CGSC offers an ideal opportunity to provide future Army leaders with the resources and tools to implement injury prevention measures and contribute to reducing the Army's injury burden.

7.5 Injury Risk Factors

An assessment of risk factors for injury during the CGSC indicated that injury in the year prior to CGSC was a strong predictor of injury treatment during CGSC for both any injury and LE overuse injury in particular. Students may arrive with an injury(ies) for which they subsequently seek treatment during CGSC. Prior injury has been shown to be a risk factor in some Army populations (USAPHC 2012; Grier, Morrison et al. 2011; Jones et al. 1993), but not all where it has been measured (Henderson et al. 2000). During the Army War College (USACHPPM 1999) and SMC (APHC (Prov). 2015), only specific injury types were a risk factor for subsequent injury. Among War College students, prior ankle sprain was a risk factor for ankle sprain while attending the War

College and among SMC students, prior LE overuse injury was a risk factor for LE overuse injury during the SMC (USACHPPM 1999; APHC (Prov) 2015).

Injury risk during CGSC was not significantly associated in multivariable models with factors traditionally seen in Initial Entry Training and other Army populations, such as gender, age, cigarette smoking, and aerobic fitness as measured by APFT run time performance (Knapik et al. 2006; Roy et al 2012; Knapik et al. 2013). However, in univariate models, associations with APFT push-up performance were statistically significant and showed a trend similar to past studies. The lowest injury incidence was observed among the highest performers and injury incidence increased with decreasing levels of performance (i.e., 24%, 33%, and 45% injured among the highest, moderate, and lowest performers, respectively). While body fat was not a significant predictor of injury in this population, the univariate model also showed results similar to past studies, in that those with the highest body fat percentages had the highest injury risk. Given the selective nature of Army schools, the variation in and effect of these risk factors are likely minimized. A prior study of injuries among the 1995 SMC class reported no independent risk factors for injury, though age, BMI, physical fitness, alcohol use, and cigarette smoking were considered (Cosio-Lima et al. 2013). An investigation of injuries in a 2013 SMC class found only 2-mile APFT run time to be associated with injury risk, though gender, age, cigarette smoking, body fat percentage, and physical training frequency were considered (APHC (Prov) 2015). Prior studies of War College students assessed risk factors for men only and did not find age, body mass index, physical fitness as measured by APFT performance, or alcohol or tobacco use to be associated with injury during War College attendance (USACHPPM 1999; USACHPPM 2000). Rather, factors such as high peak VO_2, low systolic blood pressure, lower satisfaction with life, less frequent strength training, consumption of high fat foods (USACHPPM 1999), higher bench press to body mass ratio, and more frequent sports activity (USACHPPM 2000) were associated with injury risk among War College students.

8 Conclusions

This evaluation found that cardiorespiratory endurance and muscle endurance as measured by APFT performance improved slightly over the 10-month CGSC course, and body composition and injury incidence did not change in the CGSC class with a physical therapist. Maintenance of and improvements in physical fitness are notable, given that the students were in a school environment with classroom activities that are inherently sedentary. Injury incidence did not differ from a previous CGSC class and did not change during CGSC. Overall, fitness changes could not be attributed to the presence of the CGSC physical therapist and there were no measured effects of the physical therapist on injury treatment among CGSC students.

Despite a lack of short-term impact on injuries and physical fitness, there were lessons learned about the program. Clinic use data indicated that injuries were most commonly treated by physical therapy in the class with the physical therapist (Class 14-02), suggesting that specialized injury care was being received. However, survey data indicated that the CGSC physical therapist was not specifically utilized, as only 27 percent of those referred to physical therapy were seen by the CGSC physical therapist. Only 53 percent of the class was aware that a physical therapist had been assigned to consult with and treat CGSC students and only 55 percent were aware of pre-class morning appointments available with the CGSC physical therapist at the nearby Army Wellness Center. Over three-fourths (77 percent) of follow-up survey respondents indicated they would have taken advantage of an injury prevention consultation or additional injury treatment if the physical therapist was co-located at the school.

9 Recommendations

Based on this evaluation, we cannot recommend for or against the placement of a physical therapist at the CGSC, as injury incidence did not change and physical fitness improvements could not be attributed to the program. Modifiable barriers to program implementation included the lack of formal mechanisms to engage with CGSC students, geographic separation of the physical therapist and students, and administrative challenges. To reduce these barriers, the following actions are recommended:

(1) Clearly define the intent and objectives of the CGSC physical therapist;

(2) Communicate the intent and objectives to stakeholders including the Munson Army Health Center leadership, CGSC leadership, and CGSC students;

(3) Coordinate with CGSC leadership to identify mechanisms to inform students of the injury prevention and performance optimization consultation services available through the CGSC physical therapist and to increase opportunities for interaction, with the ultimate goal of establishing routine interaction and education;

(4) Continue to offer early morning appointments at the nearby Army Wellness Center or to pursue co-location of the physical therapist, since student survey responses indicated co-location was desired;

(5) Work with Munson Army Health Center leadership to overcome administrative obstacles such as the scheduling system in order to provide the ability for the CGSC physical therapist to focus his/her patient care on CGSC students;

(6) Obtain Munson Army Health Center leadership support for the program, to ensure the CGSC physical therapist has the ability to dedicate time to CGSC injury prevention and performance optimization activities. Consider establishing a standard mechanism to capture individual and group injury prevention training in the electronic medical records system.

Evaluation of future program effects on injuries among CGSC students is warranted. While injury and physical fitness are key outcomes to assess, future evaluations should consider mechanisms of collecting additional measures such as more precise measures of time to return to duty, functional status, and quality of life. Other measures to consider include general physical health, mental health, quality of work life, and medication use (Franche et al. 2005). If educational activities are introduced at CGSC, short-term impact, such as knowledge gained from educational activities should be measured. An assessment of the long-term impact of the education and treatment received on the future health and performance of these leaders, and the health and performance of their Soldiers should also be considered.

10 Point of Contact

The APHC Injury Prevention Program is the point of contact for this project, at email usarmy.apg.medcom-phc.mbx.injuryprevention@mail.mil, or phone 410-436-4655, DSN 584-4655. Specific questions may be directed to the author(s) listed at the front of this report.

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Appendix A

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Appendix B

Initial Survey

(Note: Survey was administered electronically; length does not represent actual page length of survey and question numbers represent internal numbering system of Verint® software. Skip patterns are indicated.)

Appendix C

Follow-up Survey

(Note: Survey was administered electronically; length does not represent actual page length of survey and question numbers represent internal numbering system of Verint® software. Skip patterns are indicated.)

Appendix D

Comparison of the Survey Respondents and Non-Respondents

Survey respondents did not differ from respondents with regard to gender, Service, or Component (Table D-1). Respondents were more likely to be O4 rank (55 percent of respondents vs. 26 percent of non-respondents, p<0.01) and a higher proportion of non-respondents sought treatment for injury during the CGSC (64 percent vs. 51 percent, non-respondents vs. respondents, respectively, p=0.05). A comparison of available unit APFT records indicated few differences in physical fitness between respondents and non-respondents (Table D-2).

Table D-1. Comparison of Demographics and Injury Data from Electronic Records[a]: Survey Respondents and Non-Respondents

Variable	Category	Class 14-02, U.S. Service Members (n=296)	Non-Respondents (n=111)	Respondents (n=185)	Chi-square p-value
Gender	Male	247 (83%)	93 (84%)	154 (83%)	0.90
	Female	49 (17%)	18 (16%)	31 (17%)	
Branch of Service	Army	289 (99%)	105 (98%)	184 (99.5%)	0.13
	Navy	1 (<1%)	0	1 (0.5%)	
	Marines	2 (1%)	2 (2%)	0	
Component	Active duty	273 (92%)	105 (95%)	168 (91%)	0.39
	Reserve	8 (3%)	1 (1%)	7 (4%)	
	National Guard	11 (4%)	3 (3%)	8 (4%)	
	Other	4 (1%)	2 (2%)	2 (1%)	
Rank	O3	166 (56%)	84 (71%)	82 (44%)	<0.01
	O4	128 (43%)	27 (26%)	101 (55%)	
	O5	1 (<1%)	0	1 (<1%)	
	AA	1 (<1%)	0	1 (<1%)	
One or more injuries during CGSC	Yes	165 (56%)	70 (64%)	95 (51%)	0.05
	No	128 (44%)	40 (36%)	88 (48%)	

Note:
[a] Demographic data on Class 14-02 from initial roster obtained by physical therapist; Injury data from M-2.

Table D-2. Comparison of APFT Performance from Unit Records: Survey Respondents vs. Non-Respondents

Variable	Initial APFT results (unit records)				Final APFT results (unit records)				T-test p-values	
	Survey respondents (n=185)		Non-respondents (n=111)		Survey respondents (n=185)		Non-respondents (n=111)		Initial (respondents / non-respondents)	Final (respondents non-respondents)
	n	mean±SD	n	mean±SD	n	mean±SD	n	mean±SD		
2 mile run (minutes and seconds)	167	15.83±1.54	60	15.96±1.41	133	15.33±1.65	41	15.11±2.11	0.57	0.54
Push-ups (repetitions)	171	55.65±16.06	63	56.49±15.37	136	61.22±16.26	45	61.71±15.73	0.72	0.86
Sit-ups (repetitions)	170	67.49±13.72	61	66.21±15.63	136	69.25±13.60	43	67.09±14.80	0.55	0.37
Total score	172	249.9±39.57	64	244.5±44.36	137	259.7±39.36	45	246.0±43.18	0.37	0.05

Appendix E

Table E-1. Summary of Tobacco Use Details (Initial Survey)

Variable	Categories	Initial survey n (%)
Cigarette Use[a]		
Smoked in Last 30 Days	Yes No	6 (3%) 178 (97%)
Smoked 100 or more cigarettes in lifetime	Yes No	35 (19%) 149 (81%)
Number of Days smoked in last 30 days	1-5 6-20 21 or More Missing	2 (33%) 2 (33%) 2 (33%) 0
Age at first Cigarette	12 or younger 13-17 years old 18 or older	4 (5%) 32 (41%) 42 (54%)
Quit Smoking	Yes I quit smoking Never Smoked or Current Smoker	24 (13%) 160 (87%)
Years Quit Smoking	10 years or less 11 to 20 years 21 years or more Missing	15 (63%) 8 (33%) 1 (4%) 0
Current Smoker?	Yes No	6 (3%) 178 (97%)
Years Currently Smoking	10 years or less 11 to 20 years 21 years or more Missing	3 (50%) 2 (33%) 1 (17%) 0
Cigarettes per Day Last 30 Days	5 or Less 6 or More Missing	4 (67%) 2 (33%) 0
Smoked a Whole Cigarette	Yes No Missing	78 (42%) 106 (58%) 0
Have used e-cigarettes	Yes No Missing	55 (30%) 129 (70%) 0
Have used Smokeless tobacco	Yes No Missing	55 (30%) 129 (70%) 0
Used Smokeless Tobacco Last 30 Days	Yes No	20 (11%) 164 (89%)
Days Used Last 30 days	7 days or less 8-20 days 21 days or more Missing	1 (5%) 4 (20%) 15 (75%) 0

Variable	Categories	Initial survey n (%)
Number of Cans Last 30 days	1 or less 2 or more	8 (80%) 2 (20%)
Number of Pouches Last 30 days	4 or less 5 or more	2 (50%) 2 (50%)
Number of Plugs Last 30 days	4 or less 5 or more	3 (50%) 3 (50%)
Quit Smokeless Tobacco	Yes I quit smokeless tobacco Never Smoked or Current User	26 (14%) 158 (86%)
Years Quit Smokeless	10 years or less 11 to 20 years 21 years or more Missing	18 (69%) 6 (23%) 2 (8%) 0
Current Smokeless Use?	Yes No Missing	2 (1%) 182 (99%) 0
Years Currently Smokeless	10 years or less 11 to 20 years 21 or more years Missing	11 (55%) 8 (40%) 1 (5%) 0

Notes:
[a]Cigarette Use was defined as an individual who had smoked 100 cigarettes in their lifetime and had smoked in the last 30 days.
[b]Smokeless Tobacco Use was defined as an individual who had used smokeless tobacco products in the last 30 days.

Appendix F

Summary of Dietary Habits (Initial Survey)

Table F-1. Dietary habits, CGSC initial survey respondents (n=185)

Question	Category	N (%)
Perception of overall diet	Excellent	32 (17%)
	Very Good	69 (37%)
	Good	75 (41%)
	Fair	9 (5%)
	Poor	0
Breakfast Consumed Per Week	Never	4 (2%)
	1 to 2 times per week	24 (13%)
	3 to 4 times per week	38 (21%)
	5 to 7 times per week	119 (64%)
Largest Meal	Breakfast	12 (7%)
	Lunch	36 (20%)
	Dinner	103 (56%)
	All meals are the same	34 (18%)
Meals From Fast Food Restaurants	None	57 (31%)
	1 to 3 meals	117 (63%)
	4 to 6 meals	9 (5%)
	7 to 10 meals	1 (1%)
	More than 10 meals	1 (1%)
Cups of Dark Green Vegetables Per Day	None	16 (9%)
	1 or less cup raw or (½ cup cooked)	66 (36%)
	2 cups raw or (1 cup cooked)	75 (41%)
	3 cups raw or (1.5 cups cooked)	19 (10%)
	4 or more cups raw or (2 or more cups cooked)	9 (5%)

Table F-2. Beverage intake, CGSC initial survey respondents (n=185)

Question	Category	N (%)
Cups of Coffee Per Day	None	59 (32%)
	8 ounces or 1 cup	45 (24%)
	16 ounces or 2 cups	49 (26%)
	24 ounces or 3 cups	20 (11%)
	32 ounces or 4 cups	7 (4%)
	More than 32 ounces or 4 cups	5 (3%)
Soda Per Day	None	103 (56%)
	12 ounces or one can	59 (32%)
	24 ounces or 2 cans	14 (8%)
	More than 36 ounces or 3 cans	5 (3%)
	36 ounces or 3 cans	4 (2%)
Water Per Day	64 ounces or 8 cups	76 (41%)
	32 ounces or 4 cups	66 (36%)
	128 ounces or 16 cups	17 (9%)
	16 ounces or 2 cups	16 (9%)
	More than 1 gallon	6 (3%)
	None	4 (2%)
Energy Drinks Per Day	None	160 (87%)
	8 ounces per day	13 (7%)
	16 ounces per day	9 (5%)
	32 ounces per day	3 (2%)
Sports Drinks Per Day	None	151 (82%)
	20 ounces or 1 bottle	26 (14%)
	40 ounces or 2 bottles	7 (4%)
	60 ounces or 3 bottles	1 (1%)

Table F-3. Dietary Supplement Use, CGSC Initial Survey Respondents (n=185)

Question	Supplement/Reason	N (%)
Dietary Supplements	Do not take	133 (58%)
	Vitamins/ Multivitamins	44 (19%)
	Performance/muscle enhancement	19 (8%)
	Healthy joint	15 (7%)
	Nutrition enhancement	9 (4%)
	Weight loss	9 (4%)
Reasons for Taking Dietary Supplements (among those using supplements (n=96))	Promote general health	45 (47%)
	Greater muscle strength	24 (25%)
	Give more energy	23 (24%)[a]
	Performance enhancer	11 (11%)
	Healthy joints	12 (13%)
	Weight loss	12 (13%)
	Increased endurance	11 (11%)
	Other	3 (3%)

Note:
[a] Total >100%, as respondents could choose all that apply

Appendix G

Additional Injury Details from Survey Responses (Initial Survey)

*Note: Analysis of follow-up survey injury details for injuries that occurred during CGSC are not presented, given limited follow-up survey data (n=21 injured).

Table G-1. Limited Duty Days by Injury Type for Injuries 12 Months Prior to CGSC (Initial Survey, n=184)

Activity	Number injured (% all injuries)	Number with profile (% by activity)	Total Limited Duty Days (% all limited duty)	Average Limited duty days per injury[a]
Blunt Force Trauma	3 (7%)	2 (67%)	240 (15%)	120.0
Bursitis	1 (2%)	0 (--)	0 (--)	--
Cut/Laceration	1 (2%)	0 (--)	0 (--)	--
Dislocation	1 (2%)	1 (100%)	30 (3%)	30.0
Fracture	2 (5%)	1 (50%)	90 (6%)	90.0
Nerve Injury	4 (9%)	2 (50%)	120 (7%)	60.0
Sprain/Strain Overuse	5 (11%)	2 (40%)	395 (24%)	197.5
Sprain/Strain Traumatic	6 (14%)	2 (33%)	14 (1%)	7.0
Tear	7 (16%)	5 (71%)	426 (26%)	85.2
Other	14 (32%)	8 (57%)	306 (19%)	38.3
Total	44 (100%)	23 (52%)	1621 (100%)	70.5

Note:

[a] Weighted average: Sum of total limited duty days/(n^2)

Table G-2. Limited Duty Days by Body Area for Injuries 12 Months Prior to CGSC (Initial Survey, n=184)

Mechanism	Number injured (% all injuries)	Number with profile (% by activity)	Total Limited Duty Days (% all limited duty)	Average Limited duty days per injury[a]
Abdomen	2 (5%)	1 (50%)	30 (2%)	30.0
Ankle	3 (7%)	1 (33%)	7 (<1%)	7.0
Arm/Shoulder	8 (18%)	3 (38%)	100 (6%)	33.3
Back	9 (20%)	7 (78%)	815 (50%)	116.4
Chest/ribs	1 (2%)	1 (100%)	90 (6%)	90.0
Foot	2 (5%)	1 (50%)	24 (1%)	24.0
Hand/Wrist	4 (9%)	1 (25%)	3 (<1%)	3.0
Head/Neck	5 (11%)	2 (40%)	44 (3%)	22.0
Knee	6 (14%)	4 (67%)	388 (24%)	97.0
Leg	2 (5%)	2 (100%)	120 (7%)	60.0
Other	2 (5%)	0 (--)	0 (--)	--
Total	44 (100%)	23 (52%)	1621 (100%)	70.5

Note:

[a] Weighted average: Sum of total limited duty days/(n^2)

Table G-3. Limited Duty Days by Cause for Injuries 12 Months Prior to CGSC (Initial Survey, n=184)

Mechanism	Number injured (% all injuries)	Number with profile (% by activity)	Total Limited Duty Days (% all limited duty)	Average Limited duty days per injury[a]
Overexertion, strenuous, repetitive movement	15 (34%)	7 (47%)	543 (33%)	77.6
Struck against or struck by object	2 (5%)	2 (100%)	114 (7%)	57.0
Fall, jump, trip or slip	8 (18%)	2 (25%)	358 (22%)	179.0
Cut by a sharp tool or object	1 (2%)	0(--)	0 (--)	--
Environmental factors such as heat or cold	1 (2%)	1 (100%)	3 (<1%)	3.0
Other	17 (37%)	8 (47%)	603 (37%)	75.4
Total	44 (100%)	23 (52%)	1,621 (100%)	70.5

Note:

[a] Weighted average: Sum of total limited duty days/(n^2)

Table G-4. Limited Duty Days by Activity for Injuries 12 Months Prior to CGSC (Initial Survey, n=184)

Activity	Number injured (% all injuries)	Number with profile (% by activity)	Total Limited Duty Days (% all limited duty)	Average Limited duty days per injury[a]
Running	6 (14%)	4 (67%)	148 (9%)	37.0
Physical training (not running)	8 (18%)	5 (63%)	682 (42%)	136.4
Sports	2 (5%)	1 (50%)	3 (<1%)	3.0
Walking, hiking, or road marching	2 (5%)	2 (100%)	97 (6%)	48.5
Lifting or moving heavy object	4 (9%)	1 (25%)	30 (2%)	30.0
Stepping or climbing	3 (7%)	1 (33%)	24 (1%)	24.0
Riding or driving vehicle	2 (5%)	1 (50%)	90 (6%)	90.0
Gunshot, missile, or blast	1 (2%)	0 (--)	0 (--)	--
Other	16 (36%)	8 (50%)	547 (34%)	68.4
Total	44 (100%)	23 (52%)	1621 (100%)	70.5

Note:

[a] Weighted average: Sum of total limited duty days/(n^2)

Table G-5. Additional Injury-related Survey Data (Initial Survey, n=184)

Variable	Categories	Injuries prior to CGSC (Initial survey) n (%)
On permanent profile	Yes	11 (25%)
	No	33 (75%)
Seen by medical professional	Yes	42 (96%)
	No	2 (4%)
Injury impact	No Impact on Duty	1 (2%)
	Little Impact on Duty	10 (23%)
	Some Impact on Duty	27 (61%)
	Significant Impact on Duty	6 (14%)

Appendix H

Table H-1. Comparison of APFT data, Initial Survey vs. Unit Records

Variable	n	Self-Reported (initial survey)	Unit records (initial)	Paired T-test p-value	Pearson product-moment correlation coefficient (Self-reported vs. unit records)
		Mean ±SD	Mean ±SD		
Height (inches)	173	69.7 ±3.3	69.3 ±3.1	< 0.01	0.91
Weight (pounds)	173	181.8 ±26.6	181.6 ±26.6	0.40	0.99
BMI (pounds/inch^2)	173	26.2 ±2.9	26.5 ±2.8	< 0.01	0.93
Push-Ups (repetitions)	168	57.4 ±16.6	56.1 ±15.9	< 0.01	0.93
Sit-Ups (repetitions)	167	68.2 ±14.0	67.7 ±13.7	0.25	0.92
2 Mile Run (minutes and fraction of a minute)	165	15.6 ±1.92	15.8 ±1.51	0.07	0.78

Legend:
SD = Standard deviation

Note: The initial survey was administered 27 to 30 January 2014. The majority of unit APFT records (99.2 percent) contained information on APFTs administered before 27 January 2014. While paired t-test results indicated some statistically significant individual variation ($p<0.01$), the overall correlation of self-reported APFT results and unit records was very high (greater than 0.75).

Appendix I

Changes in APFT Performance and BMI during CGSC: APFT Unit Records for Class 14-02 and Class 13-02

Table I-1. Changes in APFT Performance and BMI during CGSC, Class 14-02 APFT Unit Records

Variable	Initial		Midpoint		T-test p-value (initial vs. midpoint)
	n	mean±SD	n	mean±SD	
2 Mile Run (minutes and fractions of a minute)	169	15.7 ± 1.4	169	15.3 ± 1.6	< 0.01
Push-Ups (repetitions)	176	57.5 ± 14.9	176	61.5 ± 16.0	< 0.01
Sit-Ups (repetitions)	174	67.4 ± 13.6	174	68.9 ± 13.9	0.07
Total APFT points	176	251.1 ± 36.3	176	257.1 ± 40.0	< 0.01
BMI (lbs/in^2)	177	26.5 ± 2.7	177	26.7 ± 2.9	0.09

Legend:
SD = standard deviation

A limited number of matched initial and midpoint APFT results were available for the prior class. A summary of results are presented in Table I-2.

Table I-2. Changes in APFT Performance and BMI during CGSC, Class 13-02 APFT Unit Records

Variable	Initial		Midpoint		T-test p-value (initial vs. midpoint)
	n	mean±SD	n	mean±SD	
2 Mile Run (minutes and fractions of a minute)	29	15.6 ± 1.5	29	15.3 ± 1.6	0.07
Push-Ups (repetitions)	30	57.0 ± 13.5	30	62.8 ± 16.5	0.01
Sit-Ups (repetitions)	30	69.9 ± 15.0	30	71.7 ± 16.8	0.38
Total APFT points	30	256.1 ± 35.9	30	265.9 ± 32.5	0.04
BMI (lbs/in^2)	32	27.6 ± 3.4	32	27.2 ± 3.3	0.03

Appendix J

Additional Injury Details from Medical Records: Injury Types and Body Regions for Injuries before and during CGSC, Class 13-02 and 14-02

Table J-1. Injury Visits by Diagnosis and Body Region (Barell Matrix) for Acute Injuries before CGSC, Class 14-02

			Fracture	Dislocation	Sprains/ Strains	Internal	Open Wound	Amputations	Blood Vessel	Contusion/Superficial	Crush	Burns	Nerves	Unspecified	System-wide & late effects	Total	%	Percent by Body Region
Head and Neck	Traumatic Brain Injury (TBI)	Type 1 TBI	0			0							0			0	0.0	0.0
		Type 2 TBI	0			0										0	0.0	
		Type 3 TBI	0													0	0.0	
	Other Head, Face, Neck	Other head					2					0	0	2		4	3.1	9.9
		Face	0	0	0		3					0				3	2.3	
		Eye					0			3		0	0			3	2.3	
		Neck	0		0		0				0	0	0			0	0.0	
		Head, Face, Neck Unspec.							0	2	0	0	0	1		3	2.3	
Spine and Back	Spinal Cord (SCI)	Cervical SCI	0			0										0	0.0	0.0
		Thoracic/Dorsal SCI	0			0										0	0.0	
		Lumbar SCI	0			0										0	0.0	
		Sacrum Coccyx SCI	0			0										0	0.0	
		Spine, Back Unspec. SCI	0			0										0	0.0	
	Vertebral Column (VCI)	Cervical VCI	0	0	4											4	3.1	3.8
		Thoracic/Dorsal VCI	0	0	1											1	0.8	
		Lumbar VCI	0	0	0											0	0.0	
		Sacrum Coccyx VCI	0	0	0											0	0.0	
		Spine, Back Unspec. VCI	0	0												0	0.0	
Torso	Torso	Chest (thorax)	3	0	1	0	0		0	1	0	0	0			5	3.8	6.1
		Abdomen				0	0		0	0		0	0			0	0.0	
		Pelvis, Urogenital	0	0	0	0	0		0	0	0	0	0			0	0.0	
		Trunk	0				0			0	0	0	0	1		1	0.8	

		Back, Buttock			1		0			1	0	0				2	1.5	
			Frac-ture	**Disloca-tion**	**Sprains/ Strains**	**Intern-al**	**Open Wound**	**Amputa-tions**	**Blood Vessel**	**Contu-sion/Su-perficial**	**Crush**	**Burns**	**Nerves**	**Unspeci-fied**	**System-wide & late effects**	**Total**	**%**	**Percent by Body Region**
Extremities	**Upper**	**Shoulder, Upper Arm**	0	0	8		0	0		0	0	0		0		8	6.1	28.2
		Forearm, Elbow	0	0	4		1	0		0	0	0				5	3.8	
		Wrist, Hand, Fingers	9	2	2		6	0		2	0	0		1		22	16.8	
		Other & Unspec.	0				1	0	0	0	0	0	0	1		2	1.5	
	Lower	**Hip**	0	0	1					0	0					1	0.8	39.7
		Upper leg, Thigh	0					0		0	0	0				0	0.0	
		Knee	0	1	3					0	0	0				4	3.1	
		Lower leg, Ankle	3	0	19			0		2	0	0				24	18.3	
		Foot, toes	2	0	1		1	0		5	0	0				9	6.9	
		Other & Unspec.	0		7		0	1	0	1	0	0		5		14	10.7	
Unclass. by Site	**Other, Unspecified**	**Other/ Multiple**	0						0			0	0			0	0.0	10.7
		Unspec. Site	1	0	5	0	0		0	6	0	0	0	2		14	10.7	
	System-wide & late effects														2	2	1.5	1.5
		Total	18	3	57	0	14	1	0	23	0	0	0	13	2	131		
		Percent	13.7	2.3	43.5	0.0	10.7	0.8	0.0	17.6	0.0	0.0	0.0	9.9	1.5		100.0	100.0

Table J-2. Injury Visits by Diagnosis and Body Region for Injury-related Musculoskeletal Injuries before CGSC, Class 14-02

			Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological	Stress Fracture	Sprains/Strains/ Rupture	Dislocation	Total	%	Percent by Body Region
Spine and Back	Vertebral Column (VCI)	Cervical VCI	79	12	13				104	17.5	44.4
		Thoracic/Dorsal VCI		0	21				21	3.5	
		Lumbar VCI	0	1	108				109	18.3	
		Sacrum Coccyx VCI	20						20	3.4	
		Spine, Back Unspec. VCI	8	2	0	0			10	1.7	
Extremities	Upper	Shoulder	110	0			0	1	111	18.7	26.1
		Upper Arm, Elbow	10	0		0		0	10	1.7	
		Forearm, Wrist	7	0		0		0	7	1.2	
		Hand	27	0			0	0	27	4.5	
	Lower	Pelvis, Hip, Thigh	8	0		0	0	0	8	1.3	25.7
		Lower leg, Knee	99	0		0	3	0	102	17.1	
		Ankle, Foot	37	6		0	0	0	43	7.2	
Unclass. by Site	Other, Unspecified	Other specified/Multiple	1	0		0	0	0	1	0.2	3.9
		Unspecified Site	19	0	2	1	0	0	22	3.7	
		Total	425	21	144	1	3	1	595		
		Percent	71.4	3.5	24.2	0.2	0.5	0.2		100.0	100.0

Table J-3. Injury Visits by Diagnosis and Body Region (Barell Matrix) for Acute Injuries before CGSC, Class 13-02

			Fracture	Dislocation	Sprains/ Strains	Internal	Open Wound	Amputations	Blood Vessel	Contusion/Superficial	Crush	Burns	Nerves	Unspecified	System-wide & late effects	Total	%	Percent by Body Region
Head and Neck	Traumatic Brain Injury (TBI)	Type 1 TBI	0			1							0			1	0.9	7.8
		Type 2 TBI	0			8										8	6.9	
		Type 3 TBI	0													0	0.0	
	Other Head, Face, Neck	Other head					0					0	0	3		3	2.6	6.9
		Face	0	0	0		0					0				0	0.0	
		Eye					0			2		0	0			2	1.7	
		Neck	0		0		0				0	0	0			0	0.0	
		Head, Face, Neck Unspec.							0	3	0	0	0	0		3	2.6	
Spine and Back	Spinal Cord (SCI)	Cervical SCI	0			0										0	0.0	0.0
		Thoracic/Dorsal SCI	0			0										0	0.0	
		Lumbar SCI	0			0										0	0.0	
		Sacrum Coccyx SCI	0			0										0	0.0	
		Spine, Back Unspec. SCI	0			0										0	0.0	
	Vertebral Column (VCI)	Cervical VCI	0	0	0											0	0.0	2.6
		Thoracic/Dorsal VCI	0	0	0											0	0.0	
		Lumbar VCI	0	0	3											3	2.6	
		Sacrum Coccyx VCI	0	0	0											0	0.0	
		Spine, Back Unspec. VCI	0	0												0	0.0	

			Fracture	Dislocation	Sprains/ Strains	Internal	Open Wound	Amputations	Blood Vessel	Contusion/Superficial	Crush	Burns	Nerves	Unspecified	System-wide & late effects	Total	%	Percent by Body Region
Torso	Torso	Chest (thorax)	3	0	1	0	0		0	2	0	0	0			6	5.2	7.8
		Abdomen				0	0		0	0		0	0			0	0.0	
		Pelvis, Urogenital	0	0	0	0	0		0	0	0	0	0			0	0.0	
		Trunk	0				0			0	0	0	0	0		0	0.0	
		Back, Buttock			3		0			0	0	0				3	2.6	
Extremities	Upper	Shoulder, Upper Arm	0	1	4		0	0		0	0	0		0		5	4.3	18.1
		Forearm, Elbow	2	0	2		0	0		0	0	0				4	3.4	
		Wrist, Hand, Fingers	9	0	2		1	0		0	0	0		0		12	10.3	
		Other & Unspec.	0				0	0	0	0	0	0	0	0		0	0.0	
	Lower	Hip	0	0	2					0	0					2	1.7	49.1
		Upper leg, Thigh	0					0		0	0	0				0	0.0	
		Knee	0	3	0					0	0	0				3	2.6	
		Lower leg, Ankle	0	0	12			0		1	0	0				13	11.2	
		Foot, toes	5	0	4		1	0		1	0	0				11	9.5	
		Other & Unspec.	0		22		2	0	0	1	0	0		3		28	24.1	
Unclass. by Site	Other, Unspecified	Other/ Multiple	0						0			0	0			0	0.0	5.2
		Unspec. Site	0	0	5	0	0		0	1	0	0	0	0		6	5.2	
	System-wide & late effects														3	3	2.6	2.6
		Total	19	4	60	9	4	0	0	11	0	0	0	6	3	116		
		Percent	16.4	3.4	51.7	7.8	3.4	0.0	0.0	9.5	0.0	0.0	0.0	5.2	2.6		100.0	100.0

Table J-4. Injury Visits by Diagnosis and Body Region for Injury-related Musculoskeletal Injuries before CGSC, Class 13-02

			Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological	Stress Fracture	Sprains/Strains/ Rupture	Dislocation	Total	%	Percent by Body Region
Spine and Back	Vertebral Column (VCI)	Cervical VCI	16	2	8				26	11.3	47.4
		Thoracic/Dorsal VCI		0	3				3	1.3	
		Lumbar VCI	0	0	60				60	26.1	
		Sacrum Coccyx VCI	6						6	2.6	
		Spine, Back Unspec. VCI	6	8	0	0			14	6.1	
Extremities	Upper	Shoulder	32	0			0	0	32	13.9	19.6
		Upper Arm, Elbow	3	0		0		0	3	1.3	
		Forearm, Wrist	1	0		0		0	1	0.4	
		Hand	9	0			0	0	9	3.9	
	Lower	Pelvis, Hip, Thigh	4	0		0	0	0	4	1.7	30.4
		Lower leg, Knee	34	1		1	0	0	36	15.7	
		Ankle, Foot	30	0		0	0	0	30	13.0	
Unclass. by Site	Other, Unspecified	Other specified/Multiple	0	0		0	0	0	0	0.0	2.6
		Unspecified Site	2	0	4	0	0	0	6	2.6	
		Total	143	11	75	1	0	0	230		
		Percent	62.2	4.8	32.6	0.4	0.0	0.0		100.0	100.0

Table J-5. Injury Visits by Diagnosis and Body Region (Barell Matrix) for Acute Injuries during CGSC, Class 13-02

			Fracture	Dislocation	Sprains/ Strains	Internal	Open Wound	Amputations	Blood Vessel	Contusion/Superficial	Crush	Burns	Nerves	Unspecified	System-wide & late effects	Total	%	Percent by Body Region
Head and Neck	Traumatic Brain Injury (TBI)	Type 1 TBI	0			0							0			0	0.0	0.0
		Type 2 TBI	0			0										0	0.0	
		Type 3 TBI	0													0	0.0	
	Other Head, Face, Neck	Other head					0					0	0	1		1	0.9	9.9
		Face	0	0	0		2					0				2	1.8	
		Eye					0			6		0	0			6	5.4	
		Neck	0		0		0				0	0	0			0	0.0	
		Head, Face, Neck Unspec.							0	0	0	0	0	2		2	1.8	
Spine and Back	Spinal Cord (SCI)	Cervical SCI	0			0										0	0.0	0.0
		Thoracic/Dorsal SCI	0			0										0	0.0	
		Lumbar SCI	0			0										0	0.0	
		Sacrum Coccyx SCI	0			0										0	0.0	
		Spine, Back Unspec. SCI	0			0										0	0.0	
	Vertebral Column (VCI)	Cervical VCI	0	0	2											2	1.8	4.5
		Thoracic/Dorsal VCI	0	0	1											1	0.9	
		Lumbar VCI	0	0	2											2	1.8	
		Sacrum Coccyx VCI	0	0	0											0	0.0	
		Spine, Back Unspec. VCI	0	0												0	0.0	
Torso	Torso	Chest (thorax)	0	0	1	0	0		0	0	0	0	0			1	0.9	4.5
		Abdomen				0	0		0	0		0	0			0	0.0	
		Pelvis, Urogenital	0	0	1	0	0		0	0	0	0	0			1	0.9	
		Trunk	0				0			1	0	0	0	2		3	2.7	

		Back, Buttock			0		0			0	0	0				0	0.0	
			Fracture	**Dislocation**	**Sprains/ Strains**	**Internal**	**Open Wound**	**Amputations**	**Blood Vessel**	**Contusion/Superficial**	**Crush**	**Burns**	**Nerves**	**Unspecified**	**System-wide & late effects**	**Total**	**%**	**Percent by Body Region**
Extremities	**Upper**	**Shoulder, Upper Arm**	0	1	4		0	0		2	0	0		2		9	8.1	27.0
		Forearm, Elbow	0	0	0		1	0		1	0	0				2	1.8	
		Wrist, Hand, Fingers	6	0	3		3	0		1	0	2		0		15	13.5	
		Other & Unspec.	0				0	0	0	1	0	0	0	3		4	3.6	
	Lower	**Hip**	0	0	9					0	0					9	8.1	41.4
		Upper leg, Thigh	0					0		0	0	0				0	0.0	
		Knee	0	2	9					0	0	0				11	9.9	
		Lower leg, Ankle	0	0	3			0		0	0	0				3	2.7	
		Foot, toes	4	0	0		0	0		0	0	0				4	3.6	
		Other & Unspec.	0		10		1	0	0	1	0	0		7		19	17.1	
Unclass. by Site	**Other, Unspecified**	**Other/ Multiple**	0						0			0	0			0	0.0	9.0
		Unspec. Site	0	0	7	0	0		0	1	0	1	0	1		10	9.0	
	System-wide & late effects														4	4	3.6	3.6
		Total	10	3	52	0	7	0	0	14	0	3	0	18	4	111		
		Percent	9.0	2.7	46.8	0.0	6.3	0.0	0.0	12.6	0.0	2.7	0.0	16.2	3.6		100.0	100.0

Table J-6. Injury Visits by Diagnosis and Body Region for Injury-related Musculoskeletal Injuries during CGSC, Class 13-02

			Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological	Stress Fracture	Sprains/Strains/ Rupture	Dislocation	Total	%	Percent by Body Region
Spine and Back	Vertebral Column (VCI)	Cervical VCI	39	1	8				48	7.4	38.2
		Thoracic/Dorsal VCI		0	68				68	10.5	
		Lumbar VCI	0	11	94				105	16.2	
		Sacrum Coccyx VCI	14						14	2.2	
		Spine, Back Unspec. VCI	10	2	1	0			13	2.0	
Extremities	Upper	Shoulder	88	31			0	0	119	18.3	22.9
		Upper Arm, Elbow	5	0		0		0	5	0.8	
		Forearm, Wrist	4	2		0		0	6	0.9	
		Hand	19	0			0	0	19	2.9	
	Lower	Pelvis, Hip, Thigh	19	5		0	0	0	24	3.7	36.0
		Lower leg, Knee	123	14		1	16	0	154	23.7	
		Ankle, Foot	51	5		0	0	0	56	8.6	
Unclass. by Site	Other, Unspecified	Other specified/Multiple	2	0		0	0	0	2	0.3	2.9
		Unspecified Site	12	0	5	0	0	0	17	2.6	
		Total	386	71	176	1	16	0	650		
		Percent	59.4	10.9	27.1	0.2	2.5	0.0		100.0	100.0

Appendix K. Risk of Injury by Demographic, Physical Fitness, and Physical Activity Characteristics, Class 14-02

Table K-1. Risk of Injury by Demographic, Physical Fitness, and Physical Activity Characteristics, Class 14-02 (Initial Survey with Medical Records, n=182)

Variable	Categories	N	Injured (%)	Risk ratio (95%CI)	p-value
Gender	Male	152	50%	1.00	0.18
	Female	30	63%	1.27 (0.92-1.74)	
Age (years)	≤34	92	53%	1.30 (0.90-1.87)	0.15
	35-39	56	41%	1.00	
	≥40	30	67%	**1.62 (1.09-2.43)**	**0.02**
Component	Active Duty	167	52%	1.00	
	National Guard	6	50%	0.96 (0.43-2.16)	0.92
	Army Reserve	8	50%	1.13 (0.47-1.95)	0.91
	Other	1	100%	--	--
MOS Group	Combat Arms	73	52%	1.00	
	Combat Support	43	37%	0.71 (0.46-1.12)	0.12
	Combat Service Support	66	62%	1.19 (0.89-1.59) **(0.39-0.92)**	0.23
Current cigarette smoking	Yes	5	53%	0.76 (0.26-2.25)	0.58
	No	17	40%	1.00	
		7			
Current smokeless tobacco use	Yes	18	44%	0.84 (0.49-1.43)	0.49
	No	164	53%	1.00	
Body fat percentage (tertiles)	21.5 or less	59	51%	1.13 (0.78-1.65)	0.52
	21.51 to 24.75	60	45%	1.00	
	24.76 or more	59	59%	1.32 (0.93-1.87)	0.12
APFT 2 mile run time (tertiles)	Fastest (15.25 or less minutes)	59	51%	1.00	
	Moderate (15.26 to 16.45 minutes)	57	51%	1.00 (0.70-1.43)	0.99
	Slowest (16.46 or more minutes)	58	50%	0.98 (0.69-1.41)	0.93
APFT sit-ups (tertiles)	Lowest (64 or less)	63	46%	0.85 (0.59-1.21)	0.36
	Moderate (65 to 75)	55	51%	0.94 (0.66-1.33)	0.71
	Highest (76 or more)	57	54%	1.00	
APFT push-ups (tertiles)	Lowest (50 or less)	71	56%	1.19 (0.85-1.66)	0.31
	Moderate (51 to 65)	48	48%	1.01 (0.68-1.50)	0.96
	Highest (66 or more)	59	48%	1.00	

Variable	Categories	N	Injured (%)	Risk ratio (95%CI)	p-value
Injury 1 year prior to CGSC	Yes No	94 83	66% 37%	**1.77 (1.29-2.42)** 1.00	**<0.01**

Variable	Categories	N	Injured (%)	Risk ratio (95%CI)	p-value
Distance run for personal PT	≤ 8 miles per week 9-12 13+	51 68 49	57% 46% 49%	1.00 0.80 (0.56-1.14) 0.86 (0.59-1.25)	 0.22 0.43
Frequency of other aerobic endurance training for personal PT	Do not perform ≥ 1 time per week	30 151	37% 55%	**0.67 (0.41-1.09)** 1.00	**0.07**
Frequency of resistance training for personal PT	Do not perform ≥ 1 time per week	25 156	60% 51%	1.19 (0.83-1.70) 1.00	0.38
Frequency of sprint training for personal PT	Do not perform ≥ 1 time per week	74 107	57% 49%	1.17 (0.88-1.54) 1.00	0.28

Note: Variables considered for multivariable model (p≤0.10) in bold.

Table K-2. Risk of Lower Extremity Overuse Injury by Demographic, Physical Fitness, and Physical Activity Characteristics, Class 14-02 (Initial Survey with Medical Records, n=182)

Variable	Categories	N	Injured (%)	Risk ratio (95%CI)	p-value
Gender	Male	152	34%	1.00	
	Female	30	50%	**1.49 (0.98-2.27)**	**0.09**
Age (years)	≤34	92	36%	1.06 (0.67-1.67)	0.81
	35-39	56	34%	1.00	
	≥40	30	47%	1.38 (0.81-2.34)	0.25
Component	Active Duty	167	37%	1.00	
	National Guard	6	17%	0.45 (0.07-2.72)	0.31
	Army Reserve	8	25%	0.67 (0.20-2.27)	0.49
	Other	1	100%	--	--
MOS Group	Combat Arms	73	34%	1.00	
	Combat Support	43	23%	0.68 (0.36-1.27)	0.21
	Combat Service Support	66	47%	1.37 (0.91-2.06)	0.13
Current cigarette smoking	Yes	5	40%	1.11 (0.37-3.29)	0.86
	No	177	36%	1.00	
Current smokeless tobacco use	Yes	18	22%	0.59 (0.24-1.43)	0.19
	No	164	38%	1.00	
Body fat percentage (tertiles)	21.5 or less	59	32%	1.14 (0.66-1.96)	0.65
	21.51 to 24.75	60	28%	1.00	
	24.76 or more	59	51%	**1.80 (1.12-2.88)**	**0.01**
APFT 2 mile run time (tertiles)	Fastest (15.25 or less minutes)	59	29%	1.00	
	Moderate (15.26 to 16.45 minutes)	57	37%	1.28 (0.76-2.16)	0.36
	Slowest (16.46 or more minutes)	58	36%	1.26 (0.74-2.13)	0.39
APFT sit-ups (tertiles)	Lowest (64 or less)	63	37%	0.90 (0.57-1.42)	0.67
	Moderate (65 to 75)	55	24%	**0.59 (0.33-1.04)**	**0.06**
	Highest (76 or more)	57	40%	1.00	
APFT push-ups (tertiles)	Lowest (50 or less)	71	45%	**1.90 (1.12-3.21)**	**0.01**
	Moderate (51 to 65)	48	33%	1.41 (0.77-2.58)	0.27
	Highest (66 or more)	59	24%	1.00	
LE Injury 1 year prior to CGSC	Yes	63	59%	**2.48 (1.68-3.66)**	**<0.01**
	No	114	24%	1.00	

Variable	Categories	N	Injured (%)	Risk ratio (95%CI)	p-value
Distance run for personal PT	≤ 8 miles per week 9-12 13+	51 68 49	41% 32% 31%	1.00 0.79 (0.49-1.26) 0.74 (0.44-1.27)	 0.32 0.27
Frequency of other aerobic endurance training for personal PT	Do not perform ≥ 1 time per week	30 151	30% 37%	0.81 (0.45-1.45) 1.00	0.46
Frequency of resistance training for personal PT	Do not perform ≥ 1 time per week	25 156	40% 35%	1.14 (0.67-1.92) 1.00	0.65
Frequency of sprint training for personal PT	Do not perform ≥ 1 time per week	74 107	39% 34%	1.17 (0.79-1.72) 1.00	0.44

Note: Variables considered for multivariable model (p≤0.10) in bold.